SOCIO-TECHNICAL TRANSITIONS IN SOUTH AFRICA'S ELECTRICITY SYSTEM

Marie Blanche Ting

Submitted in partial fulfilment for the degree of Doctor of Philosophy

Science Policy Research Unit (SPRU)

University of Sussex

United Kingdom, September 2019

DECLARATION

I hereby declare that this thesis has not been and will not be submitted in whole or in part to another University for the award of any other degree.

Signature:……..

Marie Blanche Ting

ACKNOWLEDGEMENTS

This research was funded by the Doctoral programme at the Science Policy Research Unit (SPRU), University of Sussex. I am very grateful for this generous support. Without such financial aid, the prospects of studying in the U.K. would be a distant hope. May it continue to offer more opportunities, particularly for scholars that come from the Global South.

My special gratitude to Robert Byrne and Matias Ramirez, my supervisors, who from the beginning, provided thorough, constructive feedback, rigorous research, endless patience, and unwavering support. Their guidance and numerous discussions over the years will forever shape my future research. I also want to thank my prior supervisor Lucy Baker, for her time and helpful feedback during the early stages of the PhD process.

This journey began long before it officially started, as I have been encouraged and intellectually inspired by many scholars and practitioners. Special mention goes to Phillipe Laredo and Velaphi Msimang for being generous with their time and feedback. Also, my gratitude goes out to the Sussex Mandela Scholarship Fund, that funded by Masters, prompted my plans to study further, and continues to be an inspirational community back home in South Africa.

During my PhD, I was appreciative for the opportunity to contribute to the Transformative Innovation Policy Consortium (TIPC), an inspiring initiative that brings new ways of thinking in innovation policies in many parts of the world. I especially want to acknowledge Chux Daniels, who provided endless motivation, open style of collaboration, and his overall generosity, particularly for early career researchers like myself, to succeed. Thanks to Johan Schot, and the TIPC community for being a source of dynamic intellectual deliberations, and in general the collegial research experience. Furthermore, my PhD journey was enriched by the SPRU faculty, and the Sussex Energy Group (SEG), who always opened their doors whenever I needed support and have made the studies an enjoyable research experience. I am thankful for Benjamin Sovacool for

his enthusiasm and constant encouragement for the success of my PhD. I am finally at the end!

I also want to express my gratitude to the Mapungubwe Institute for Strategic Reflection (Mistra) for hosting me during my fieldwork in Johannesburg and offering opportunities to present my research outputs. I am forever indebted to my interviewees, who provided their time and inputs during my fieldwork.

As with most PhD journeys, it is an endeavour which can take many years, most often away from the comfort of home, family and friends. I am therefore grateful for friends, that have made Brighton my home, especially Andrea Laplane, Chantal Naidoo, Paloma Bernal Hernandez, Kejia Yang, Claudia Obando Rodriguez, Sungjoo Lee, and Sandra Pointel, who became my source of continuous support, motivation, reassurance, and overall friendship. Hopefully, our PhDs is only the beginning of a lifelong collaboration. To my fellow PhD cohorts, I am glad to be part of such a wonderful community, who will no doubt, go on their way to lead many new ways of thinking in our field. Per Aspera ad Astra!

My friends Andile Mzinyati and Vanessa Van Gelder, Simisha Elias, Yameng Lee-Thorp thanks for the support throughout my thesis and bringing some normality to my nomadic life.

To my mom, whose constant prayers keep me safe, secure and sound. Who would have predicted that a girl from Zamboanga to Danao in the Philippines to East London in the Eastern Cape in South Africa, could have journeyed to the U.K. in pursuit of a PhD? Thanks to my parents and extended family, who has made it all possible.

Finally, to Makgano, your patience, emotional support and empirical critique, throughout my studies, has had immeasurable impact. I am eternally grateful for your love, companionship, and belief in me. You have regularly pushed me to grow and to think of my PhD beyond intellectual pursuits, and one that has practical meaning at home. I am finally finished, but I hope that we never stop being intellectually curious and continue enjoying the adventures that life has given us.

A quote that has motivated the start of my PhD:

> *"It takes courage to release the familiar and seemingly secure to embrace the new. When we stay in situations that are unfulfilling because we are afraid or we won't find anything better, we are not safeguarding our happiness but starving it. Our hearts long for more, because we are meant to shine, and make the most of our time here. It's in the consciousness of wanting more destined for higher things. There is no security in what is no longer meaningful. There is more security in the adventurous and exciting. For in movement there is life, and in change there is power".*

UNIVERSITY OF SUSSEX

MARIE BLANCHE TING

DOCTOR OF PHILOSOPHY IN SCIENCE AND TECHNOLOGY POLICY STUDIES

SOCIO-TECHNICAL TRANSITIONS IN SOUTH AFRICA'S ELECTRICITY SYSTEM

SUMMARY

In the last century, markets, technical configurations, existing power relations, and prevailing ideologies in industrialised countries have co-evolved in ways that promote fossil-fuel-based systems. Relatedly, the literature on sustainability transitions (STs) has gained significance in the last twenty years, primarily because of increased interest by those who are concern with enabling shifts towards low-carbon sources of energy. This research examines the kinds of changes which take place in fossil fuel path-dependent systems in response to the pressure imposed by the advent of greener alternatives. Understanding how fossil-fuelled path-dependent systems respond to such demands enables us to identify counter-strategies, which may help accelerate sustainability transitions.

Using a combination of the multi-level perspective on socio-technical transitions and institutional theory, the thesis presents case studies centred on South Africa's coal-fired electricity regime, which is entrenched in a system known as the minerals-energy complex (MEC). The case studies examine how the coal-fired electricity regime tried to maintain stability in the face of pressure to decarbonise by diversifying to include more renewables-based and gas-fired electricity generation, each of which is considered as a niche.

The findings from the case studies are organised into three articles. The first paper presents a case study on the establishment of the MEC and shows how it became a

highly path-dependent system, posing a formidable obstacle and challenge for new entrants. The second paper investigates the contestation between the dominant regime incumbent, Eskom, versus the nascent renewable energy programme. This paper demonstrates an evolving strategy of regime resistance in response to several gains achieved by the renewables niche over time. The third paper examines the emergence of a gas-to-power niche against a backdrop of interactions between electricity and liquid fuel regimes. This paper shows the highly dynamic changes that take place in a regime as it tries to maintain stability.

The overall findings demonstrate that the electricity regime evolved from highly stable to having features of a *fractured* regime, or what could be understood to be a form of destabilisation. The thesis contributes to the ST field by suggesting several ways in which regime stability and change could be better understood. These include enhanced theorising of regime resistance through analysis of the regime's multi-dimensional selection environment and mobilising endogenous institutional concepts through various modes of change (drift, layering, conversion and displacement) into the theory. Policy recommendations suggest a *fractured* regime requires a temporally sensitive displacement policy mix. This is one in which varying stages of regime stability are recognised and potentially exploited by corresponding niche strategies.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AMEU	Association of Municipal Electricity Undertakings
ANC	African National Congress
BEE	Black Economic Empowerment
CCGT	Close Cycle Gas Turbine
COSATU	Congress of South African Trade Unions
DMR	Department of Mineral Resources
DOE	Department of Energy
DTI	Department of Trade and Industry
DPE	Department of Public Enterprise
EAF	Energy Availability Factor
EIUG	Energy Intensive Users Group
ERA	Electricity Regulation Act
FSRUs	Floating Storage Regasification Gas Unit
Gas I4P	Gas Independent Power Producers Procurement Programme
GHG	Green House Gas
GIU	Gas Industrialisation Unit
GW	gigawatts
IPAP	Industrial Policy Action Plan
IPPs	Independent Power Producers
IRP	Integrated Resource Plan
ISMO	Independent Systems Market Operator
KZN	Kwa-Zulu Natal
LNG	Liquefied Natural Gas

LTMS	Long-Term Mitigation Scenario
MEC	Mineral Energy Complex
MLP	Multi-Level Perspective
MPRDA	Mineral and Petroleum Resources Development Act
MYPD	Multi-Year Price Determination
NERSA	National Energy Regulator of South Africa
NUM	National Union of Mineworkers
Numsa	National Union of Metalworkers South Africa
OCGTs	Open Cycle Gas Turbines
PFMA	Public Finance Management Act
PPAs	Power Purchase Agreements
PV	Photo Voltaic
PGMs	Platinum Group Metals
Refit	Renewable Energy Feed-In Tariff
RE I4P	Renewable Energy Independent Power Producers Procurement Programme
SADC	Southern African Development Community
SALGA	South African Local Government Association,
SDGs	Sustainable Development Goals
SOEs	State Owned Entities
ST	Sustainability transitions
TWh	terawatt-hours
tcf	trillion cubic feet
UCLF	Unplanned Capability Loss Factor

CHAPTER 1

INTRODUCTION

In the last century, markets, technical configurations, existing power relations, and prevailing ideologies in industrialised countries have co-evolved in ways that promote fossil-fuel-based systems (Grin et al., 2010; Kanger and Schot, 2019). However, alongside this dominance in fossil fuels, is the call for urgent needs to address affordable and clean energy access as part of the broader UN Sustainable Development Goals (SDGs) (United Nations, [UN] 2015).

In line with this, is the growing field of sustainability transitions which has gained significance in the last twenty years, mainly because of rising interests by those who are concern with enabling the shift towards sustainable and inclusive economic growth (Markard et al., 2012; Schot and Kanger, 2018). Sustainability transitions field calls for a broad socio-technical radical change that is needed along with societal domains in energy, mobility, housing, and finance, amongst others (Schot and Kanger, 2018). A socio-technical system is characterised by co-evolutionary and linked material and social elements that influence the functionality and development of a system (Grin et al., 2010). Such a system consists of a combination of actors, networks, institutions, artefacts, infrastructure, markets and practices that together fulfil a societal function or needs (Geels, 2004; 2011).

Sustainability transitions are considered radical, not necessarily in speed but due to the scope in changes of user practices, cultural meanings, industry structures, markets, policies, technologies, and supporting infrastructures (Geels and Schot, 2010).

In this regard, a prominent framework for understanding the dynamics of socio-technical change is the multi-level perspective (MLP) (Geels, 2002a; Geels and Schot, 2007), which delineates transitions as an interplay amongst three analytical levels. These levels are niches, which refer to protected spaces where radical innovation takes place; regimes, which pertain to established practices, routines and associated rules that

enable and constrain actors within existing systems; and landscapes, which encompass long-term exogenous trends (Geels and Schot, 2007; Geels, 2002a; Rip and Kemp, 1998). Essentially, the assumption with respect to these analytical levels is that as a landscape exerts enough pressure on a regime to cause destabilisation, a window of opportunity arises for niches to scale up and diffuse. The traditional practice in ST research is to represent niches as 'green innovations', which challenges existing and mostly fossil fuel-based regimes to move towards sustainable transformation. Examples of green innovation include renewables such as solar PV systems, wind turbines, electric vehicles and heat pumps (Grin et al., 2010). In unsustainable regimes, counterpart technologies refer to traditional, deeply entrenched fossil fuel-based systems meant to service vehicles that run on petrol and coal used for electricity generation as a few examples that lock in production and consumption patterns (Schot and Kanger, 2018). The majority of MLP analyses have focused on 'bottom-up' change models, which distinguish between 'heroic' green innovations and transitions (Geels, 2014b; Geels, 2011).

Conversely, in a more recent evolution of the MLP framework, ST scholars have noted that a transition to sustainable pathways is likely to be slow, uneven and delayed because of resistance from regimes (Geels, 2014b; Hess, 2014; Kuokkanen et al., 2018). Thus, given the urgency of environmental challenges and the need for an alternative to examinations concentrated in 'green' niche innovations, the processes of regime resistance, destabilisation, decline and erosion are regarded as equally important (Turnheim and Geels, 2013; Geels, 2014b; Smith et al., 2010; Geels et al., 2016; Karltorp and Sandén, 2012; Kuokkanen et al., 2018; Kungl and Geels, 2018).

First, part of the problem in the lack of attention paid to the regime is its conceptualisation as a 'monolithic bloc', which refers to a conventional understanding of the regime as homogenous, coherent structures, dominated by rational action and neglecting essential differences in context (Smith et al., 2005). In this definition, the regime undergoes endogenous incremental change, whereas abrupt radical changes are exogenous: they are found either in the landscape, beyond the reach of a regime, or in niches, which are considered protected spaces where variety and novelty emerge (Smith et al., 2005). In this definition, the regime undergoes endogenous incremental change, whereas abrupt radical changes are exogenous and found in the landscape that is

beyond the reach of a regime, and niches which are considered protected spaces where variety and novelty emerge (Smith et al., 2005). In this orientation, the regime concept has been criticised because it fails to account for internal tension, conflict, power, politics and agency (Meadowcroft, 2011; Geels, 2014b; Smith et al., 2005). Therefore, seeing, as fossil fuel-based regimes are likely to resist the expansion of low-carbon systems, an improved understanding of how regimes respond to changes should be an integral part of the ST literature.

Second, a regime is assumed to be stable under the theoretical frames of lock-in, path dependency and inertia (Unruh, 2000), which underpin the ideas that the reproduction of routines, practices and associated rules foster regular and automatic patterns (Geels, 2014b). Countering such views, scholars in the field underscore the dynamic nature of regime behaviour: as actively resisting change (Geels, 2014b), as shaping regime rules through an institutional process (Genus, 2012; Fuenfschilling and Truffer, 2014; Smink et al., 2015), as reorienting towards radical innovation (Berggren et al., 2015; Penna and Geels, 2015) and as engagement in multiple-regime interactions (Raven and Verbong, 2007; Sutherland et al., 2015). Correspondingly, portraying a regime as passive or inert underestimates its crucial role in STs.

Third, research has also centred on the deliberate phasing out of mature, unsustainable regimes (Rogge and Johnstone, 2017; Stegmaier et al., 2014), which could contribute to accelerating the diffusion of niche innovations.

Fourth, criticisms have been directed towards the applicability of the regime concept in more complex settings, such as those found in the Global South, which is characterised by the potential for the hybrid character of incumbent systems, flexible institutional embedding and higher forms of uncertainty (Wieczorek, 2018). Raven (2005), suggested that partial regime instability is needed for niche innovations to breakthrough. However, it is not evident in literature, whether levels of fragmentation or absolute regime destabilisation is needed, which favours niche development. These issues point to the need for further research that can articulate and unravel the nuances of the relationship between regime stability and niche. Such nuances, in turn, imply ways to accelerate sustainable transitions, particularly under Global South conditions.

Reconciling all the four perspectives regarding the regime concept reveals the necessity of additional explorations into comprehending regime stability and change in the ST literature. One of the approaches to learning more about this relationship is the concept of 'semi-coherent' alignment of rules, which constitutes a regime (Geels and Schot, 2010).

A well-known definition of a regime is as follows:

> A regime is a rule set or grammar embedded in a complex set of engineering practices, production process technologies, product characteristics, skills and procedures … all of which are embedded in institutions and infrastructure
>
> (Rip and Kemp, 1998, p. 340)

Accordingly, Geels and Schot (2010) explained that regimes become unstable when actors begin to diverge and disagree on basic rules. This disagreement can be a source of change when tension arises, as is the case in a mismatch between different types of rules, or when actors begin to adopt different ideas, preferences, values and interests (Geels and Schot, 2010, p. 44). Building on these ideas is the notion that underlies the mobilisation of institutional theory from which to analyse regime stability and change (Geels, 2004a; Fuenfschilling and Truffer, 2014). The persistence of a regime has been increasingly recognised as stemming from highly institutionalised social structures of regulative, normative and cognitive rules (Fuenfschilling and Binz, 2018). This means that the greater the degree to which these rules are embedded within society, the stronger the institutionalisation of a regime, which in turn has implications on its stability. Thus, given that rules form the heart of the stabilising and organising features of the socio-technical regime, a focus on analysing rule changes should reveal the dynamism of regime stability and change. To test these assumptions, and to generate insights, which can contribute to ST literature on regime stability and change, an empirical case study analysis of a highly entrenched socio-technical regime is needed.

South Africa provides an excellent example of an emerging economy with a historically energy-intensive economy which has ambitious plans to lower its carbon emissions. The country has articulated a need to transition to a low-carbon economy,[1] with plans to

[1]National Planning Commission (NPC), Chapter 5, Transitions to a low-carbon economy. https://www.nationalplanningcommission.org.za/assets/Documents/NDP_Chapters/devplan_ch5_0.pdf

implement a Just Transitions pathway.[2] A Just Transitions plan is considered a comprehensive sustainable development plan for the country and covers water, land, food security and energy issues, in order to shift into a low-carbon, climate resilient economy and society by 2050. However, the urgency of environmental sustainability is placed alongside other equally critical developmental goals, known locally as the triple challenge: reducing inequality, poverty reduction and job creation (National Planning Commission [NPC], 2012). In terms of trying to achieve sustainability, South Africa has the complex task of balancing salient trade-offs and synergies between multiple priorities and objectives in different sectors.

Using a combination of a multi-level perspective (MLP) framework (Geels, 2002a) and institutional theory (Streeck and Thelen, 2005), the current research explores the ways in which the dynamics in South Africa's electricity regime are playing out as it struggles to achieve a more sustainable energy system. Specifically, South Africa has a well-established coal-based electricity regime embedded in what is known as the minerals-energy complex (MEC), a term used to describe a tight configuration of industries associated with mining, electricity and infrastructure which are essential to South Africa's economy (Fine and Rustomjee, 1996). More recently, however, there have been attempts to diversify the electricity regime towards more sustainable practices. This research investigates the potential displacement of South Africa's coal-fired electricity generation with renewable energy and gas. Conceptually, the MEC is a socio-technical system within which there is the electricity regime, and Eskom is the dominant regime incumbent. Both renewable energy and gas-fired electricity generation are undeveloped in South Africa and so, for this research, are characterised as niches.

1.1 Background and overview of the South African electricity system

South Africa's electricity regime has historically been embedded in what is known as the MEC, in which a co-evolution of mining, energy and industrial development has been crucial to growth and development in the country. It is estimated that South Africa's mineral wealth value is around USD $2.5 trillion (GCIS, 2012). The MEC has a concentrated economic and political power that is held in the hands of a small number

[2]Developing models and pathways for a low-carbon economy and resilient society. https://www.sustainable.org.za/project.php?id=55

of actors who have a privileged influence over energy and economic policy, as well as over access to and distribution of investments. For instance, the biggest mining companies in South Africa have significant investments within the Johannesburg Stock Exchange (JSE), and these also belong to an Energy Intensive Users Group (EIUG) which collectively (including associated industries such as materials beneficiation and materials manufacturing) account for 44% of the electricity demand in the country.[3]

Furthermore, mining contributes 7% to the GDP, 25% of the exports and 2.5% of the labour force (Baxter, 2016; Statistics South Africa [StatsSA], 2017). A vital component of the MEC is Eskom, a state-owned vertical monopoly electricity supplier which uses coal as its primary resource. Coal production and consumption are intricate parts of the economy as they provide the country with revenues derived from a range of activities from export, mining and industry to synthetic fuels (Ting, 2015).[4] Consequently, South Africa has one of the highest carbon footprints for some emerging economies – 9 tons per capita (tpc) of carbon emissions, almost on par with Organisation for Economic Co-operation and Development (OECD) countries' average of 9.5 tpc.[5] Thus, in a sense, South Africa suffers from a tight 'lock-in' of a high carbon pathway due partially to its dominant coal-fired electricity generation.

In 2018, South Africa's total electricity generation was from coal (83%), nuclear (6%), pumped storage (1.9%), independent power producers (IPPs) (4%), open cycle gas turbines (OCGTs) (peak 0.1%) and international purchases (3.2%) (Figure 1.1) (Department of Energy [DOE], 2018a).

[3]Energy Intensive Users Group (EIUG), www.eiug.org.za
[4]Ting (2015), included in this thesis as Chapter 4.
[5]World Bank, carbon dioxide emission data, https://data.worldbank.org/indicator/EN.ATM.CO2E.PC [accessed 1 March 2019].

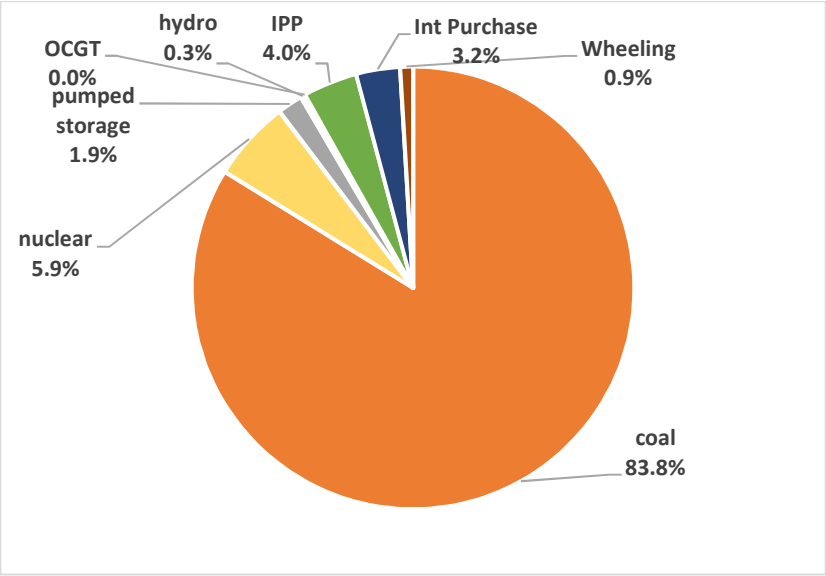


Figure 1.1: Total electricity generation for South Africa's electricity system (DOE, 2018a).[6]

Although South Africa has known since 1997 from its White Paper on Energy that an electricity deficit would be reached by 2007, no new plants have been commissioned in time (Department of Minerals and Energy [DME], 1998). Thus, with an ageing electricity infrastructure and lack of maintenance due to low generation reserves, the country has undergone a series of blackouts since 2008. Moreover, the continued reliance of South Africa's electricity regime on coal is increasingly under threat following the electricity shortfall, and under pressure to decarbonise, the regime is experiencing a period of rapid change involving the introduction of new sources of energy technologies and new actors. In response, to diversify its energy security, an integrated resource plan (IRP) was initiated, and in 2012, it was implemented in an ambitious Renewable Energy Independent Power Producer Procurement Programme (RE I4P) with some indicators of success, albeit on a limited scale compared to the overall supply (DOE, 2015a; DOE, 2018a). By 2018, South Africa had procured approximately 6.4 gigawatts (GWs) of renewable energy generation projects, of which 3.2 GWs were operational and synchronised to the grid (DOE, 2018a). Additionally, from 2015, a gas independent power producers procurement programme (Gas I4P) was also initiated, totalling 3.6 GWs for power generation (DOE, 2016). Furthermore, in parallel, two new coal plants

[6] Wheeling here is defined as access between a non-Eskom generator (NEG) and Eskom to facilitate trading of energy. The NEG uses the national grid to transport electricity from where it is produced to a location of end use. http://www.eskom.co.za/Whatweredoing/Pages/Wheeling_Of_Energy.aspx

with a combined installed capacity of 9.6 GWs for the national grid are being implemented (DOE, 2018a).

Considering the country's plans for additional coal usage and the initiation of gas as a power source, it appears that there will be increasing investments in fossil fuels and the associated infrastructure. It should be clear, then, that South Africa's energy policy could be characterised as contradictory: on the one hand, it promotes sustainable development while, on the other, it promotes the extraction and consumption of polluting (and unsustainable) resources. As such, South Africa is facing a difficult period in the transition of its energy systems while working within sustainability constraints, mainly because there are powerful vested interests at play when considering the influences of the MEC, as well as the social dimensions of employment in the coal industry linked to trade unions. It is this continued carbon lock-in and the attempts by the South African government to achieve certainty of the country's electricity supply that provides the context for this research. This leads to the main research question.

1.2 Research question, audience and relevance

What explains stability and change in South Africa's electricity regime over time?

This research seeks to understand how South Africa's deeply entrenched coal-based electricity regime is attempting to maintain its stability in the face of the pressures and threats from renewable energy and gas-fired electricity generation.

This thesis's primary academic audience consists of those concerned with sustainability transition (ST). Here, I have two research objectives: the first is to open up the analysis on the regime as this is a known source of inertia and path dependency. In this way, the thesis aims to contribute to ST by finding ways that can effectively unlock regimes, and by implication, accelerate the diffusion of niche innovations. The second objective is to investigate the applicability of the regime concept as it is found in Global South contexts. In this regard, some scholars have noted the complexity of higher forms of uncertainty found in Global South conditions (Ockwell et al., 2018; Wieczorek, 2018; Swilling et al., 2016; Baker et al., 2014). There is, therefore, a need to better understand the regime as it is found in these complicated settings.

A second audience to which the thesis aims to contribute is the community of practitioners concerned with electricity changes in South Africa. The country has a well-established coal-based electricity system, but it is under pressure to decarbonise to a lower carbon trajectory. Against this background, there is increasing momentum for a 'Just Transition' pathway (NPC, 2012) in which there are plans for an inclusive, climate resilient society. Here, the research aims to contribute to the domestic agendas on climate change and inclusive economic growth and, at the same time, provide insights into similar emerging economies that are attempting to achieve their sustainable development goals.

1.3 A brief introduction to the theoretical lens

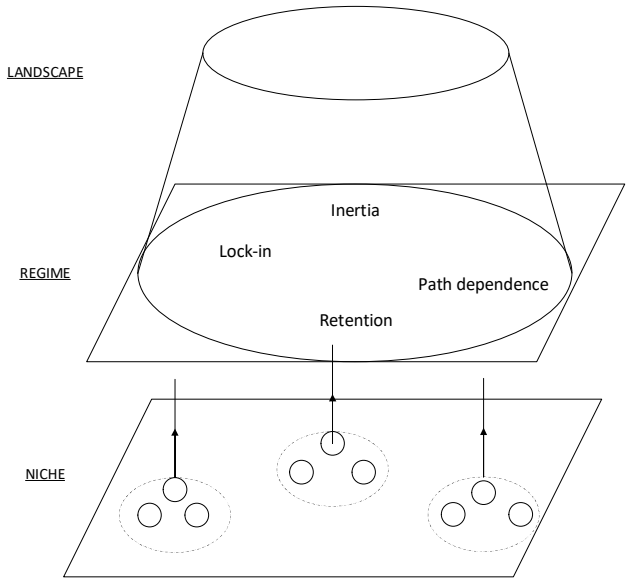


Figure 1.2: A multi-level perspective (MLP) illustrating the main theoretical concepts in the regime, adapted from (Geels, 2002a; Wieczorek, 2018).

In an attempt to contribute to the ST literature, the primary focus of this research is on the role of regimes in stability and change.

Socio-technical regimes are characterised as path-dependent because they involve five factors: (1) incumbent actors who have been vested in maintaining the status quo, (2) a network of actors that represent organisational capital, (3) regulations and standards that enable continuity of the regime, (4) cognitive routines and practices that can blind

actors to realities outside of their own focus and lastly (5) material elements such as infrastructure enabling lock-in due to sunk investments (Verbong and Geels, 2007)

The evolution of the MLP regime concept in earlier transition research was based on theoretical knowledge of evolutionary economics and neo-institutional theory. As elaborated in Chapter 2, these concepts tend to favour an inherent bias towards processes of stability and resilience. For instance, in evolutionary economics, there is an emphasis on routines, bounded rationality and market selection, whereby firms choose instead to 'satisfice than optimise' (Geels, 2014a, p. 263). However, part of the limitation in evolutionary economics is that it downplays intentionality and strategy and that it has a lack of concern for the role of beliefs, cognitions and interpretation of the actors (Geels, 2014a).

Similarly, while neo-institutional theory sees actors competing for social legitimacy rather than economic efficiency, the view is of actors as 'cultural dopes' that simply conform to its institutional pressures (Geels, 2014a). Both theoretical insights brought forth the notions of technological trajectories, path dependency, inertia and lock-in, explaining that technological innovation develops incrementally (Dosi, 1982; Rip and Kemp, 1998; Unruh, 2000). Hence, there is the inclination to accept the regime as a 'monolithic bloc' subject to a radical change from exogenous shocks (Figure 1.2).

In line with this concept is the idea that radical change is brought about at the level of a niche (Geels, 2002). Hence, the MLP tends to assume that, as the regime becomes unstable, a window of opportunity is created for a niche to develop. However, it is not evident in the literature on how regime instability can lead to niche opportunities (Smith, 2007; Geels and Schot, 2007). Moreover, several scholars have indicated that Global South countries tend to be in a constant state of flux due to greater levels of uncertainty in their political and economic conditions (Wieczorek, 2018), with the potential for varying degrees of regime stability over time (Köhler et al., 2019). Accordingly, Köhler et al., (2019), indicated that more research is needed which can provide empirical insights into the various forms of regime stability, particularly from the Global South, other than the presumed monolithic concept. In line with Köhler et al., (2019) call, this research focuses on opening up the analysis on the regime.

To do so, it is argued that a punctuated equilibrium approach to understanding regime change is limiting. This is because punctuated equilibrium implies a sharp distinction between long periods of incremental change on the one hand, and abrupt radical change on the other (Mahoney and Thelen, 2010; Sorensen, 2014). In the MLP literature, the tendency is to assume incremental change within the regime, while radical innovation takes place in the niche. This conceptualisation can be problematic because, according to notable institutional scholars, the punctuated equilibrium approach is more helpful in understanding resilience than change (Streeck and Thelen, 2005, p. 6). Moreover, institutions do change while appearing to show stability or not change while there is an exogenous shock (Pierson, 2004). As Mahoney and Thelen (2010) reason, there could be internal institutional reconfigurations during times of apparent stasis or stability. This research contends that there is potential value in analysing endogenous regime changes (apart from incremental change) in response to pressure from its internal and external environment as it plays out during a transition.

Thus, this research uses an institutional theory approach because it helps to focus the analysis on the rules that provide the stabilising features of regimes. The rules are regulative (laws, standards), cognitive (beliefs, search heuristics) and normative (values) (Scott, 2014). The understanding is that rules are endogenous organising and coordinating features that guide the behaviour of a set of actors in a regime (Geels and Schot, 2010). Hence, it is the reproduction of these rules, through routines, practices, and norms in society, which maintain regime stability. Conversely, when the interpretation of these rules starts to diverge, this can be the sources of conflict, as actors begin to disagree on shared ideas, preferences, standards and beliefs (Geels, and Schot, 2010). Accordingly, analysing rule changes is one of the ways in which regime stability and change can be evaluated.

An evolved conceptualisation of the regime includes the use of institutional theory (Geels et al., 2016; Andrews-Speed, 2016; Smink et al., 2015; Fuenfschilling and Truffer, 2014; Geels, 2004a), as well as expanding structuration theory to delineate actors' use of rules (Schot and Kanger, 2018). Fuenfschilling and Truffer (2014) in particular, operationalised the regime as the dominant institutionalised structure in an organisational field, subject to constant negotiation between strategic actors. Thus,

Fuenfschilling and Truffer (2014), characterises regime stability as levels of structuration and degrees of institutionalisation.

To elaborate, this thesis defines an organisational field as a selection environment in which technologies are selected by the society in which they are embedded, where the selection mechanisms have material, political, cultural and sociological characteristics. It is for these reasons, that the regime is considered highly institutionalised structure because once technologies are adopted in society, there is a process of 'retention' and 'reproduction' – or 'lock-in' – that occurs through established regulations, market parameters such as scale and sunk investments, as well as sociological structures that include cognitive routines, and power and politics, making changes away from the retained technologies difficult (Geels, 2014b; Smith and Raven, 2012; Meadowcroft, 2011; Geels and Schot, 2010).

An organisational field includes a community of actors who interact with each other to produce similar services or products (Dimaggio and Powell, 1983). This thesis considers the community of actors to include businesses, suppliers, producers, user groups (households, industries), societal groups (civil society) and public authorities (e.g. regulators, national ministries) (Geels, 2004a)

Structure is a foundational concept in ST, taking into consideration that it is both a medium by which actors draw upon rules and resources and an outcome of social practices (Giddens, 1984). Therefore, in this thesis, I develop a meta-conceptual framework that delineates regime stability as levels of structuration with an associated agency (Chapter 3). These various degrees of regime stability are conceptualised as high, limited and low. In these various forms of regime stability, I then use institutional theory (discursive institutionalism and endogenous institutional theory) to reveal the kinds of internal regime changes in relation to shifting core rule changes over time. The assumption is that, the greater the rules are institutionalized in society, the greater the stability. By inference, the instability of the regimes is a process of dis-embedding of these rules.

In sum, by using changes in rules to examine regime stability and change, there is then an opportunity to open up the regime to more endogenous scrutiny and not simply considering it as a 'monolithic bloc'.

1.4 Research design/methodological approaches

This thesis assumes that the nature of socio-technical transitions involves complex dynamics, non-linearities, and structural change (Geels and Schot, 2010). The MLP, in particular, focuses on co-evolutionary interactions between ongoing trajectories, and a selection environment that is multi-dimensional because it involves markets, regulations, social legitimacy and infrastructure (Geels and Schot, 2010).

For these reasons, transitions research requires a methodological approach that is rich in context and tracks complex developments over time. A qualitative case study approach is seen to provide such a method because it allows detailed study of event sequences and identification of patterns and their underlying mechanisms (Geels and Schot, 2010).

Overall case study choice and the unit of analysis

The research question of how incumbents and institutions interact is set against the background of a fossil fuel system transition that proceeds gradually. South Africa was chosen as a case study because it has an example of a coal-based electricity regime that is highly path-dependent but is undergoing significant changes. Revealing the ways in which a regime responds to changes could provide meaningful research into sustainability transitions. My unit of analysis was based on the rules of the regime, reasoning that efforts to maintain, alter, reinterpret and repurpose can reveal the dynamics of regime stability and change.

Selection of specific case studies

The case studies were selected according to the establishment of the country's electricity regime (stability), and the kinds of regime responses in relation to the two niches (change). In doing so, analysing both the establishment and changes to the regime should provide rich theoretical and empirical insights into the ST literature. The thesis is organised into three papers, which form the empirical case studies.

The first paper traces the establishment of the country's MEC (Chapter 4), which outlines the relationship between mining and energy in South Africa's energy sector. This relationship provides a contextual preamble of a highly path-dependent and historically derived carbon-intensive energy sector.

The second empirical case study considers the RE I4P renewable energy programme and its relationship with the dominant incumbent, Eskom (Chapter 5). The main objective of this case is to examine regime resistance through a multi-dimensional regime selection environment.

The third study investigates the Gas I4P (Chapter 6) and examines multiple regime interactions between electricity and liquid fuels.

Data collection

In terms of data collection, this includes multiple sources of evidence using both primary and secondary data. For primary data collection, I used qualitative, in-depth semi-structured interviews supplemented with field notes, documenting remarks, reflections and views throughout the fieldwork (See Appendices A and B).

Secondary data included document reviews of government policies and strategies, scientific articles, books, doctoral theses and reports published in the grey literature (see Appendix C).

The data analysed in the empirical cases were collected in two phases:

1) The first phase of fieldwork took place in Johannesburg, Pretoria with follow-up teleconference calls from June to October 2015.
2) The second phase of fieldwork took place in Johannesburg, Pretoria and Cape Town from March to July 2016.

The purpose of the first phase was to pilot the case studies in order to evaluate the theoretical concepts with empirically grounded research. The first phase, had a broad range of relevant stakeholders, including experts in the field, government authorities and researchers were interviewed in order to determine the relevance of some of the preliminary research ideas and themes. Moreover, there was an opportunity to familiarise with the case studies, establishing contacts, gathering preliminary data, and

expanding interviewees by a snowballing method. This phase effectively expanded the number of interviewees, references and access to official documents.

The second phase of the fieldwork built upon the first phase by going into more depth with some interviewees and initiating additional interviews in order to widen the research as much as possible. For the Gas I4P, I did follow-up interviews in February 2018 to update the relevance of my findings. A snowball technique is used from the chosen interviewees and contacts. The selection of interviewees was based on ensuring that actors from government, Non-Government Organisations (NGOs), the private sector, academia and think tanks were included (Table 1.1, Appendices A and B). Across these two phases, I conducted 67 semi-structured interviews. The duration of interviews was anything from 30 minutes to more than 2 hours.

Furthermore, another literature review (theoretical and empirical) was undertaken to incorporate some of the insights gained after the first phase. Consequently, a more evolved interview protocol was prepared to better suit the case studies. In this instance, in refining the design of the case studies, the goal was an analytical generalisation, providing an opportunity that may modify, reject or expand current research (Yin, 2013, p. 41). To do so, I operationalised the normative, regulative and cognitive rules' outline in the regime and related them to the adapted endogenous institutional modes of drift, layering, and conversion (Streeck and Thelen, 2005). After, operationalising the analytical concepts from the MLP (niche and regime) and endogenous institutional modes of change, I translated them into questions that could be comprehensible to the interviewees.

In general, semi-structured interviews were useful for gaining nuanced and deep insights into the decisions made by different actors, while also providing flexibility to explore other insights that may be relevant. Moreover, the semi-structured interviews focussed on probing areas of tensions, compromises and instances of collaboration, in order to go deeper than publicly available material can provide.

Table 1.1 List of interviews indicating the type of actors who were interviewed

Interviews by organisation						
Industry/ private sector	State-owned enterprises (SOEs)	Government ministries	Think tanks	Consultants	Academia	NGOs
18	5	16	6	7	9	6
Final Total						67

Data analysis

For the analysis, I combined the different sources of information (academic literature, newspaper articles, policy documents, organisational websites, see Appendix C) and interviews according to the MLP dimensions and triangulated these as far as possible. I chose to anonymise all respondents who took part in my research. Each empirical chapter outlines the methodology concerning the types of institutional theory used.

On triangulation, I identified several kinds of issues that needed to be addressed, each of which is elaborated below along with concrete examples of the strategies I used to address them. These strategies were applicable in all three papers:

1) In preparation for interviews, I would use statements made by interviewees in public documents such as newspaper articles, parliamentary hearings, government documents (see Appendix C) and pose them as questions or points for clarification.

I weighed these claims against multiple sources of evidence. For example, gas development has been claimed as a 'game changer' in the country's energy landscape (DOE, 2016b, p. 24) (see Chapter 6). Moreover, there were claims that gas could provide greater flexibility to the electricity grid in order to counter the intermittency of renewables, as well as reduce the risk of creating stranded assets due to its modular infrastructure (DOE, 2016). As part of triangulation, I asked interviewees about evidence to support or otherwise such claims (and see below on opposing claims).

2) In trying to establish a fact, as in determining dates and events, I used multiple sources of evidence.

For example, in the case of the multi-year price determination (MYPD), which is an annual electricity price increase, specific events were determined through publicly available documents such as the National Energy Regulator of South Africa (Nersa) (see Chapter 5). Here, Nersa has detailed accounts of the MYPD process in which Eskom outlined its reasons for price increases through customer growth projections, sales volume, plant performance, and the costs of IPPs, among others. From these documents, I was able to determine the different cycles of the MYPD, which was important to trace the development of the RE I4P and Eskom's operational performance over time (MYPD 1= 2006-2009, MYPD 2= 2009-2012, MYPD 3=2013-2018) (see Chapter 5).

3) In trying to establish the validity of opposing claims, I interrogated a range of information in order to make an assessment. But see point 4 on opposing claims that could not be resolved.

For example, Eskom had claimed the following:

"Eskom wishes to assert that it remains committed to government's energy procurement programmes and intends to sign budget quotations and power purchase agreements related to these programmes (RE I4P). This commitment … takes into consideration value for money and whether South Africa's customer base can afford the IPP tariffs."[7]

These claims were weighed against multiple sources of evidence (interviews and grey literature). For instance, in contrast to supporting renewables, Eskom had publicly delayed the progress of the RE I4P by blocking power purchase agreements (PPAs) (see Chapter 5). Moreover, the argument of value for money could no longer hold, as the bid prices for renewables became competitive with the new coal plants Medupi and Kusile.

[7] Eskom, (2017), Eskom supports renewables, but flags cost-recovery uncertainty as a worry. http://www.eskom.co.za/AboutElectricity/FactsFigures/Pages/EskSupprtRenewbls.aspx [Accessed 1 August 2019]

Furthermore, there were claims that Eskom "frustrates the entry of IPPs and private investment through the disingenuous use of facts, the political brinkmanship and what lawyers' term malicious compliance, through the quiet subversion of government policy by actions such as delayed access or inflated grid-connection costs for IPPs." (Eberhard, 2016). In this case, I compared the evidence relevant to Eskom's claim of supporting the RE I4P. Given the numerous sources supporting the position that Eskom resisted the RE I4P compared with those claiming the opposite (most of which were from Eskom), it is most likely that Eskom did resist the progress of renewables, and this is further supported by considering that renewables were a threat to the status quo that clearly benefited Eskom.

4) In cases where there were opposing claims that could not be resolved using available evidence, I stated the claims but took the discussion no further.

For example, there were claims that Eskom is included in the broad issues related to 'state capture', which is a term used to describe state-owned entities who are exploited – through procurement allocations, for example – to benefit powerful elites (PP, 2016; Budlender, 2017; Bhorat et al., 2017). In this instance, there have been opposing claims. In one claim, Eskom denies allegations of 'state capture', in the "absence of concrete evidence of wrongdoing" (Creamer, 2016). However, there are multiple sources of evidence claiming Eskom has been involved in awarding coal contracts that did not follow due diligence, which is an indication of fraud (see more in PP, 2016; Budlender, 2017; Bhorat et al., 2017). Establishing the validity of these claims would require substantial evidence, especially given the sensitivity of the allegations. Doing so was beyond the capacity of my resources and would, in any case, add little to my analysis. Instead, I decided to state these claims (see Chapter 5) in order to highlight an aspect of the political economy associated with Eskom, but I did not take the issue any further.

1.5 Thesis arguments and contributions

This research combines the MLP with institutional theory, as lenses in which to analyse regime stability and change. The thesis contribution helps to explain, the kinds of responses the regime has in relation to the shifting core rules, as it plays out in a transition over time. It provides a more nuanced understanding of the dynamism in

regime stability and change. This, therefore, adds to our knowledge on regime destabilisation, erosion, decline, and suggestions for phase-out. I delineate the contributions into theoretical, empirical, and policy recommendations.

Theoretical

First, this thesis reveals that, in all three case studies, there was no neat pattern of scale-up from the niche level to destabilise South Africa's electricity regime. Instead, there is an evolution of a highly stable regime towards features of a *fractured* regime as a gradual form of destabilisation. In this thesis, 'fractured' refers to different types of regime changes that emerged depending on the structural conditions of the regime over time. To elaborate, *maintenance* of the regime was possible when the structural conditions were relatively stable, but regime actors began to *reform* and *reinterpret* and started to *defect* from, existing rules as the structure became weak. Hence, the understanding of regime changes is more nuanced than simply incremental, appreciating the role of structures in regime stability and change more fully.

This notion of a fractured regime contributes to ST research, by appreciating the possibility of progressive endogenous regime changes that can add up to destabilisation in contrast to the assumed concept of a regime as a monolithic bloc, subject to exogenously induced punctuated change. It is worth noting that the van Welie et al. (2018) reference to a splintered regime is different from the fractured regime as defined in this thesis. Van wellie et al., propose the coexistence of complementary heterogeneous regimes in the Nairobi sanitation sector, each of which has its own unique set of characteristics depending on social fitness and spatial configuration.

Second, this thesis delineates specific parts of the regime selection environment that enables regime resistance. In this case study, the dominant incumbent, Eskom, made use of the various dimensions in its selection environment, particularly discursive structures, to resist the rise of renewables. Conversely, discursive structures were also helpful for the niche by influencing the terms of the debate, exacerbating regime tensions and gaining public support. Thus, discursive structures were useful dimensions to reveal regime–niche dynamics. However, it may be different in other cases, and so

more research is needed in making use of the regime multi-dimensional selection environment to further theorise regime resistance and niche challenges.

Third, I argue that the implication of regime instability on niche opportunities is emergent and dynamic. For example, as the structure of the regime becomes weak, then the organisational field opens up to more actors that have various preferences, interests and ideas, resulting in different opportunities for strategic deliberation and negotiation. The assumption that too much regime instability causes a decrease in niche opportunity has instead, in this case, study, revealed a niche opportunity. Hence, a better nuance is needed between the implication of regime stability and a niche because this relationship would be dependent on the actors' present, their ability to change the rules, their access to resources, organisational field conditions and temporal sequences that may already have unfolded.

In sum, this thesis examines the strategic actions by regime actors over rule changes as a way of maintaining their preferred regime selection environment. It is through these varying regime responses, which helps explain the kinds of agency expressed in relation to the structural change in a regime. Thus, the findings of this research provide a more nuanced elucidation of the dual nature of the regime, in the form of fractured destabilisation.

Empirical

South Africa is deliberating on the need to shift its energy systems towards a Just Transitions pathway. This research suggests that to do so, both the decline in the use of coal and stimulating alternatives need to be tackled simultaneously so that a direction towards sustainable development becomes feasible. Directionality requires deliberate attempts to abandon existing unsustainable pathways because failing to do so can mean existing trajectories may simply be replicated or extended.

Policy recommendation

The research recommends that instead of wholesale destabilisation policies, a *fractured* regime requires a temporally sensitive 'displacement' policy mix. This is one in which varying stages of regime stability are recognised and potentially exploited by

corresponding niche strategies. Each of these points is further elaborated in Chapter 7, which summarises the critical contribution of the research.

1.6 Outline of the thesis

This thesis is organised into seven chapters, which includes this introductory Chapter 1. Each chapter of the thesis is discussed in more detail in the subsequent paragraphs.

Chapter 2: A literature review

This chapter begins with a discussion on ST as the primary academic audience on which I base my thesis. Next, I discuss a few prominent theoretical lenses from the sustainability transition literature, giving my rationale for selecting the MLP as my chosen framework. This is followed by a critique of the literature gap regarding regime concepts, such as regime resistance, regime destabilisation and regime–niche linkages. Given these gaps, I suggest that institutional theory could be a useful lens through which we can focus on how to contribute towards a more nuanced understanding of the dynamism in regime stability and change.

Chapter 3: Conceptual meta-framework

The conceptual meta-framework was developed in order to find a way of problematising regime stability into parts that enable the study of regime stability and change. To do this, regime stability was delineated into three parts: high, limited and low, defining them according to the dual nature of a regime, which is structure and agency. I then discuss two theoretical frameworks – discursive institutionalism and endogenous institutional theory in Chapters 4 and 5–6, respectively. It was expected that institutional theory would provide useful theoretical concepts in which to operationalise changes in regime rules because rules provide the stabilising features of regimes. Moreover, endogenous institutional theory, derived from Streeck and Thelen (2005), stems from a theoretical approach, which challenges the notion of punctuated equilibrium, because it is argued to be better at explaining institutional resilience than institutional change (Streeck and Thelen, 2005). Moreover, these authors provided four endogenous incremental rule changes, which were drift, layering, conversion and displacement. Drift, layering and conversion were then operationalised in Papers 2 and 3, as a way to analyse regime responses to the pressure derived from the renewables and gas niches,

respectively. Displacement was not covered by any of the papers but is included in Chapter 7 where that discussion builds on the findings from Papers 2 and 3. It was expected that such analysis could reveal the complexity associated with endogenous regime change and therefore, open up the analysis on the regime.

The next three chapters outline the three papers (Table 1.2), which form the empirical case studies.

Chapter 4: Historical review of the relationship between energy, mining and the South African economy

The main research question here is:

How and why did South Africa's MEC become a powerful, entrenched regime?

The purpose of this research was to trace the establishment of rules and resources that resulted in the creation of the MEC and how that enabled Eskom to maintain its dominance in the system.

This chapter forms the first empirical case study and was published in October 2015 as part of a book entitled *Earth Wind and Fire: Unpacking the Political, Economic and Security Implications on the Green Economy* (Ting, 2015). The chapter is a detailed analysis of the MEC in South Africa, where the core rules of the electricity regime are embedded. It demonstrates the entrenched nature of the MEC and provides the empirical context of South Africa's electricity regime. It also explains the institutionalisation of the MEC into a prominently obdurate structure which demonstrates a formidable obstacle and challenge for new entrants.

Chapter 5: Eskom and the rise of renewables: regime resistance, crisis and the strategy of incumbency in South Africa's electricity system

The main research question here is:

How has Eskom responded to the introduction of renewable energy electricity generation in South Africa?

The purpose of this research was to examine the kinds of endogenous regime change that took place when the regime was subjected to pressure from a renewable niche.

This chapter discusses a contribution to a more nuanced understanding of regime resistance and regime niche linkages by characterising the regime selection environment as the battleground whereby strategic actors compete to influence and shape outcomes. The empirical case study is on South Africa's dominant regime incumbent Eskom versus the recently introduced RE I4P. Drift and layering were used as analytical concepts in which to observe incumbent resistance and niche development, respectively, based on analysing struggles over rule changes. Drift was useful in understanding how Eskom responded to change and thereby maintained stability. Drift occurs when rules within the regime remain constant despite the change in situational context (Streeck and Thelen, 2005). Mostly, Eskom was able to delay, resist and slow the progress of the RE I4P over time. It was able to do this through evolving resistance strategies that were hidden to open and visible contestation with the RE I4P. Initially, Eskom had resisted the introduction of the RE I4P by confining debates to hidden spaces amongst its organisational networks, such as inaction on policy reforms, delaying market changes and moderating the need for additional electricity generation and information asymmetry. However, continuous resistance strategies meant that the electricity regime failed to adapt to changing circumstances, which led to a significant crisis, as demonstrated by massive blackouts in the country from 2008 through 2019. This crisis provided a window of opportunity for the renewables niche, and the IPPs programme was implemented in such a way that it was not an attack on Eskom's monopoly power, which was considered as layering. Layering is defined as new rules added alongside existing ones. In this research, layering revealed that the introduction of the RE I4P did not require, nor did it result in, a complete destabilisation of the regime incumbent. Instead, the steady progress of the RE I4P coexisted alongside the Eskom's dominance. Geels et al. (2016) adaptation of Streeck and Thelen (2005) layering concept described it as incremental adjustment and called it 'fit-and-conform' in which niche innovations are developed within the existing regime selection environment. Layering is feasible when an institutional environment is not conducive to radical disruption, therefore allowing new and old institutions to coexist over time.

As the RE I4P niche made significant material gains, Eskom's drift strategy of close and hidden contestation appeared to be failing. Thus, Eskom then evolved its resistance into

open and visible arenas of contestation by finding other ways to exploit its incumbency. These strategies involved blocking the finalisation of RE I4P contracts, changing grid connection rules and recruiting political support and action through the regime's organisational networks by drawing the powerful trade unions into the contest.

The paper concluded that a systematic analysis of rule changes in a regime selection environment is a significant way to demonstrate regime resistance and niche challenges. This, in turn, has implications on characterising regime resistance more fully and identifying the types of policies that can erode its power in favour of more sustainable regimes.

The overall relevance of this paper to the thesis is that it revealed the kinds of regime and niche actions that emerged as the renewable niche coexisted alongside the dominant incumbent, Eskom. It showed early forms of regime disintegration as regime actors began to diverge and disagree on the core rules, which resulted in limited regime stability.

Chapter 6: Multiple regime interactions, conversion, and South African liquefied natural gas (LNG)

The research question here is:

> *What explains regime interactions in the course of developing South Africa's LNG for power and industrial use?*

The purpose of this paper was to examine the kinds of endogenous changes which take place when a regime has undergone some form of regime instability.

This chapter discusses a contribution to ST literature on multiple regimes' interaction in institutional terms and the lack of empirical research on the development of gas-to-power and industrial use in South Africa. To illustrate this, the case study traces the emergence of South Africa's LNG for power and industrial use, considered a niche, against a backdrop of two established regimes. These were electricity and liquid fuels, which we argued developed a closer interaction over time, as observed through conversion. Conversion defines institutions as 'multipurpose tools' which means they can be used at differing ends, depending on who is powerful enough to utilise them in their favour (Hacker et al., 2015). The mechanisms of conversion are the redirection of

the institutional resource over political or other forms of mediation and contestation over what functions and purposes an existing institution should serve (Hacker et al., 2015).

Applying these insights, it becomes evident that the interaction between the two regimes was motivated by landscape pressures due to regional gas discoveries and significant shale gas potential in the country's Karoo region, as well as significant global trends in LNG on trade, gas prices and liquefaction. In parallel, the persistent electricity crisis, which started in 2008 and continues to the present, caused significant tension within the electricity regime. Thus, the electricity sector was described as engaging in a 'distant search' because options for radical alternatives and new knowledge bases were explored. One suggestion is that the LNG niche has the potential to increase institutionalised norms and practices because it has the support of powerful extractive base industries present in both regimes. This is evident by changes in industrial mindsets, at least in the extractives industry, and the inclusion of gas in the country's national development plans, which suggests that gas is increasingly embedded within the normative goals of both regimes. Changes in core beliefs, mission and identity, are considered deeper forms of institutional change (Geels, 2014a). This means that linkages between the two regimes can lead to an enduring connection and more significant configurational transformation (scope and depth) over time.

From 2015, the electricity regime was encouraged to implement the LNG niche given the relative success of the IPP policy instrument used to introduce the RE I4P, as well as a shared similarity of an already well-established liquid fuels regime. The DOE, an electricity regime actor, planned to import LNG to provide an 'anchor demand' for electricity generation and collaborate with the Department of Trade and Industry (DTI), a liquid fuels regime actor, to beneficiate LNG for industrial use for an overall gas economy in the country. Thus, the two regimes had interacted because of perceived opportunities and mutual benefit derived by developing the LNG niche. They did so by repurposing existing cognitive, normative and regulative rules, which were considered as conversion. In this way, new institutions are not created, but instead, existing ones are repurposed to serve new goals or interests. However, the repurposing of existing rules was not a simple process; it required a series of cohesive efforts to develop linkages

between the two regimes. These efforts required the interface between the two regime communities to refine technical knowledge, operational processes, infrastructure development and the funding mechanisms necessary to implement the LNG niche. Over time, a gradual expansion of shared industrial mindsets, maturity in knowledge basis and societal expectations developed, which led to the alignment of interests and the formation of actor networks between the two regimes.

The paper highlights the significance of an actively resourceful electricity regime which had repurposed an existing policy instrument at first used for RE I4P, but subsequently adapted it to procure gas, coal and other energy sources from IPPs. The research findings demonstrate the implication of how powerful actors can modify or co-opt existing institutions and redirect them for their own benefit.

The overall relevance of this paper to the thesis is that electricity regime actors continued to diverge from and enact the core rules differently. This was evident by aligning several efforts with the liquid fuels regime to develop the LNG niche. As such, as the electricity regime stability decreased, repurposing existing institutions was necessary. Likewise, ST can unfold in different directions but is subject to ongoing mediation amongst strategic actors at a given time.

Chapter 7: Discussion and conclusion

This chapter revisits the research questions, synthesises the results from the empirical cases and discusses the main contributions of the work. This research concludes that combining institutional theory and the MLP provided a useful theoretical framework for analysing regime stability and change. Finally, there is a discussion on the limitations of the study and recommendations for future research are posited.

Summary

This chapter has introduced the main theoretical concepts and empirical context for this thesis. Primarily, this thesis aims to contribute towards closing the gap in ST research related to regime stability and change. Given that regimes are known sources of inertia and resistance, the empirical cases for this research can provide theoretical and empirical contributions by analysing how an emerging economy such as South Africa is trying to achieve its sustainable development goals. Table 1.2 outlines in detail the three

papers which form the empirical cases for this thesis. The next chapter is a literature review on the main theoretical frameworks used in ST, justifying the case for the MLP. This is followed by the significance of institutional theory in helping to focus the use of rules as units of analysis for examining regime stability and change.

Table 1.2: A summary of the three papers presented in this thesis, outlining the main research questions, and its overall significance

Papers	**Paper 1**	**Paper 2**	**Paper 3**
Title	Historical review of the relationship between energy, mining and the South African Economy.	Eskom and the rise of renewables: regime resistance, crisis and the strategy of incumbency in South Africa's electricity system.	Multiple regime interactions, conversion and South African Liquefied Natural Gas
Aim of the research	An in-depth case study on the role of mining in the development of the energy sector in South Africa.	An empirical case study on South Africa's electricity regime that demonstrates the contestation between an entrenched incumbent, namely the state-owned utility Eskom versus the nascent RE I4P.	The paper examines the emergence of Gas I4P in South Africa against a backdrop of liquid fuels and electricity regimes.
Secondary research questions	How and why did South Africa's MEC become a powerful, entrenched regime?	How has Eskom responded to the introduction of renewable energy electricity generation in South Africa?	What explains the regime interactions in the course of developing South Africa's LNG for power and industrial use?
Conceptual approach	Discursive, institutional theory	Endogenous institutional theory using the modes of drift and layering	Endogenous institutional theory using the mode of conversion
Significance	The analysis demonstrates the entrenched nature of the MEC and provides empirical context. The chapter explains the institutionalisation of the MEC into a prominently obdurate structure which demonstrates a	The paper reveals the dynamics of regime resistance and niche–regime interaction in institutional terms. The paper's central insights are the ability of the entrenched incumbent to contest change in both closed and open	The paper reveals that a cumulative effect of landscape changes and regime tensions influences the search heuristics to another regime, depending on perceived similarities in both functional and operational

	formidable obstacle and challenge for new entrants.	areas. By operationalising the regime selection environment as a battleground for rule changes, regime resistance was characterised more systematically. The implications are pertinent to the discussion of theorising regime resistance.	parameters. Thus, in an effort to search for solutions, a regime repurposed existing cognitive, normative and regulative rules to favour the gas niche. The significance of this research was to demonstrate that the regime enabled the development of the gas niche.
Dissemination	Chapter in a book: TING, M. B., 2015. Historical Review of the Relationship between Energy, Mining and the South African Economy. *In:* MYTELKA, L., MSIMANG, V. & PERROT, R. (eds.) *Earth, Wind and Fire: Unpacking the Political, Economic and Security Implications of Discourse on the Green Economy.* Johannesburg: Real African Publishers.	This has been published as an article in *Energy Research and Social Science* (ERSS). Presentation: 1st Energy Research and Social Science conference, 2-5 April 2017, Sitges, Spain.	This chapter has been published as a working paper: TING, M. B., 2019. Multiple Regime Interactions, Conversion, and South Africa's Liquefied Natural Gas. *SPRU Working Paper Series (SWPS),* 08**,** 1-30. Presentation: Trade and Industrial Policy Strategies (TIPS) Annual forum, Innovation and Industrialization, 30-31 May 2019, Midrand, South Africa

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, a literature review on sustainability transitions (ST) literature is discussed, focusing on the MLP and institutional theories as frameworks for this thesis. As outlined in Chapter 1, this research uses endogenous institutional theory to analyse the kinds of effort taken by the regime in response to shifting core rule changes over time.

The next section outlines the MLP as the primary framework in the research. The MLP has traditionally been comprised of the evolutionary terms of selection, variation and retention. In particular, the regime has been conceptualised as highly stable, where lock-in and path dependency persist (Geels and Schot, 2010). However, there are conceptual limitations of the regime, such as the tendency to understand it as a 'monolithic bloc', or stability is perceived as automatic due to its path-dependent properties (Section 2.1.5). Hence, some scholars have a more evolved understanding of the regime which mobilises institutional theories to describe regime stability as levels or degrees of institutionalised structures (Fuenfschilling and Truffer, 2014). Thus, I introduce concepts related to the institutional theory of reproduction (Section 2.2) and change (Section 2.3), leading to a discussion on the duality of the regime (Section 2.4).

2.1.1 Sustainability transitions

The ST community has produced significant theories, concepts and debate concerning fundamental shifts in the social and economic systems necessary in achieving inclusive, sustainable growth. For these reasons, I consider STs as sources of information that guide the research task.

The urgency to address sustainability challenges has grown over the last few decades because of rapid depletion in natural resources, rising greenhouse emissions, air pollution and energy security and access, amongst others (Markard et al., 2012), all of which have been articulated in the United Nations (UN) sustainable developmental goals (SDGs) (UN, 2015). Due to the inter-relatedness amongst the challenges in achieving sustainable development, the term transitions have been used to frame a need for systemic changes (Smith et al., 2010). Transitions scholars believe that a systemic change is needed in societal domains that encompass energy, mobility, housing and finance, amongst others (Smith et al., 2010; Schot and Kanger, 2018). These systems require radical changes in production, distribution and consumption (Markard et al., 2012; Schot and Kanger, 2018).

In a similar deliberation, an emerging research agenda called 'transformative innovation policy', an initiative between academics and policymakers, is finding new ways to frame innovation policies that are relevant to achieving the SDGs (Schot and Steinmueller, 2018; Kuhlmann, 2018; Diercks et al., 2019). Sustainable development is a crucial issue amongst this transformative innovation policy community, and there is a critical reflection on the role of current innovation policies which may be the source of externalities such as climate change and exclusive economic growth.[8] The thinking is that innovation policies need to be democratised (broad participation of actors), inclusive (addressing issues of capacity and access) and resilient (addressing issues relative to vulnerable and marginalised groups). Thus, part of the discussion on transformative innovation policy speaks to the ST field, where there is a need to understand unlocking path-dependent systems, through experimental forms in policy engagements (Schot et al., 2019). I have been part of the Transformative Innovation Policy Consortium (TIPC) initiated by the Science Policy Research Unit (SPRU) since 2016, undertaking fieldwork in Ghana, Kenya, Senegal and South Africa. I have witnessed first-hand, amongst senior policymakers and practitioners, the urgent need to align national innovation plans with the SDGs. It has been clear from these deliberations and engagement in this community that a step change from the norm is needed. There is a

[8]Transformative Innovation Policy Consortium (TIPC). http://www.tipconsortium.net/

growing understanding in this community that technological choices are not neutral, but instead, they are a socially driven co-evolutionary process.

Overall, in STs, the focal point for change is usually centred around the 'technological regime', which represents a dominant and persistent configuration of a societal system. (Rip and Kemp, 1998; Grin et al., 2010). This is discussed in subsequent sections.

Technological regime

From its inception, transition scholars were concerned with strategies for reorienting or managing regimes towards sustainability (Markard et al., 2012). Such interest resonated with the concerns of sustainability researchers, with research focusing on a transition away from fossil fuel energy systems towards a shift in low-carbon development (Rip and Kemp, 1998; Smith et al., 2010).

The 'technological regime' was first introduced by evolutionary economists Nelson and Winter (1982) primarily to describe the shared beliefs, heuristics and routines used by engineers to find solutions for a given problem. In evolutionary economics, actors are presumed to act in bounded rationality,[9] and searching for solutions to problems tends to be localised and close to existing routines. These shared routines are what Dosi (1982) calls a technological paradigm that aggregates towards a pattern and subsequently to a natural, technological trajectory. Over time, Rip and Kemp (1998) refined this concept by adding rules that are embedded not just within engineering practices but in a much more extensive range that encompasses production processes and skills.

Geels (2002a) developed the concept further by using the term socio-technical regimes so that social groups that include policymakers, users and scientists are as crucial in socio-technical systems. A socio-technical system is characterised by the co-evolutionary linkages between material and social elements and has an influence on the functionality and development of a system (Grin et al., 2010). Such a system consists of a combination of actors, networks, institutions, artefacts, infrastructure, markets and practices which together fulfil a societal function or needs (Geels, 2004; 2011).

[9]Bounded rationality is defined by Geels (2011, p. 30) as a type of agency which is restricted to routines, search activities and learning by trial and error.

In this way, a socio-technical regime is defined as a collection of varying actors that operate amongst different sets of regulative, cognitive and normative rules (Scott, 2014) which guide their activities towards functions that meet societal needs (Bosman et al., 2014; Geels and Schot, 2010). By broadening the regime concept further (beyond markets and science), a reconceptualization began to include socio-institutional dimensions. Smith et al. (2010) noted the following:

> A sociological sensibility extends the regime notion to embrace institutions (such as regulations and markets), heterogeneous networks (including devices and people), user relations, and social expectations. Mutual reinforcement across these plural processes creates the structural patterns that shape innovation and creates trajectories of social development.
>
> (p. 440)

Given this socio-technical perspective, regimes are considered stable and path-dependent, because they are constituted from a co-evolutionary accumulation and alignment of the following: (1) incumbent actors which have become vested in maintaining the status quo, (2) a network of actors that represent organisational capital, (3) regulations and standards that enable continuity of the regime, (4) cognitive routines and practices that can blind actors to realities outside of their own focus and, lastly, (5) material elements such as infrastructure that enable lock-in due to sunk investments (Verbong and Geels, 2007).

Against this background, ST scholars have been concerned with strategies that contribute to regime shifts, arguing that a broad systemic change is achieved through user practices, cultural meanings, industry structures, markets, policies, technologies and supporting infrastructures (Geels and Schot, 2010). Here, there are three frameworks that have achieved some significance in ST research. These include the MLP, strategic niche management (SNM) and transition management (TM). I have investigated these in turn in order to determine a suitable framework within which to anchor my research task.

2.1.2 Different theoretical lenses applied in ST literature

MLP

The MLP is a heuristic tool that seeks to understand the complex dynamics of socio-technical change (Geels, 2002a; Rip and Kemp, 1998). It defines transitions which interface changes at three levels: experiments with innovative practices at the niche, structure and established practices and associated rules (the regime) and long-term, exogenous trends (the landscape) (Geels, 2004c; Geels, 2011). These three levels are functional relationships amongst actors, structures and practices that are interlinked (Raven and Verbong, 2007; Geels, 2004c). These levels are not meant to be hierarchical but to be interpreted at different levels of structuration and stability (Geels and Schot, 2010). This means the higher the level, the greater the coherence and alignment of activities amongst actors, institutions, organisational networks and the markets over time (Grin et al., 2010). The main assumptions are that system innovations start in socio-technical niches, diffuse, and breakthrough due to the linkages between developments at multiple levels (Geels, 2004c). Examples which describe changes using the MLP are sailing to steamships (Geels, 2002a), horse-drawn carriages to automobiles (Geels, 2005) and cesspools to sewer systems (Geels, 2006).

SNM

Closely related to the MLP, SNM is concerned with the deliberate creation and support of a niche to stimulate regime shifts (Schot and Geels, 2008; Kemp et al., 1998; Raven and Geels, 2010). Niches are defined in MLP as protective spaces wherein a radical alternative is safeguarded from the same selection pressures operating on the regime. According to Smith et al. (2010), a niche is dependent on a multitude of actors who enable legitimacy and, ultimately, the broader adoption of niche innovation. SNM scholars have expanded on the critical dynamics associated with niche development in four processes: expectations, learning, network formation and societal embedding (Smith and Raven, 2012; Byrne, 2011; Raven, 2005). Related to expectations, these are promises that technology may provide a worthwhile social or commercial future. Therefore, time and effort are invested for it to succeed. Learning is about experimentation on niche technologies that lead to an improvement in performance or

economic feasibility (Schot and Geels, 2008). Social networks sustain expectations or articulate new demands and enable more resources for niche development. Societal embedding refers to how niche technologies are institutionalised within society and the diffusion of niche structures into the mainstream (Byrne, 2011).

Niche actors that succeed in creating protection constructs do it in a manner that involves active support from regime actors. A niche does not exist in isolation, nor can it be shielded indefinitely. At some point, contestation between the regime and niche actors is inevitable. Smith (2007) alluded to this by indicating that niches alone are unlikely to transform regimes. Successful transitions would have to include positive critical feedback from niches, such as profit, meeting societal needs that are insufficient within the regime and a critical mass of actors (from the regime and niches) who have aligned interests. The particular relationships involved with how niches link to or confront a stable regime under conditions of change that can lead to transition is under the studied topic. It is presumed that linkages occur in a 'haphazard' way (Smith, 2007, p. 431), and there is no account of regime stability with varying stages of niche development (Geels and Schot, 2007). A niche innovation must align with expectations dominant in the regime, and so would be constrained or enabled through dominant regime structures.

The SNM literature would not be suitable as a framework for this thesis, as it is more concerned with niche formation and development. For this research, the analysis is concerned with the regime itself and the implication of regime changes on niche development. However, it is acknowledged that the findings of this research contribute to SNM, as opening up the analysis on the regime can reveal insights for practical strategies that could enable niche development.

TM

TM is a set of governance tools aimed at purposely creating transition arenas with the regime, niche and other actors, where they envision and jointly experiment with new pathways to sustainability (Rotmans et al., 2001; Loorbach, 2010; Schot and Geels, 2008). The goal is to actively influence the regime through niche experiments, problem structuring reflexive monitoring and evaluation. TM considers that change in achieving

sustainable development (Loorbach, 2010) requires 1) long-term goal setting, 2) promoting change in structures, cultures and practices and 3) learning about different perspectives. TM concentrates on tackling change at the regime level. In this respect, Loorbach (2010) suggests that barriers, such as regulations, institutions, consumer routines and infrastructures, be addressed through a coalition of authoritative actors. In this way, a change originates within a regime, as a transition is translated within an organisation. The TM approach has been applied in various European countries, but it has been acknowledged that its applicability and diffusion to other countries remains untested. In a more critical interpretation, Schot and Geels (2008, p. 542) emphasised that many of the visioning exercises prescribed by TM have become an 'impression management' tasks, where there is a limitation in translating them to real-life experiences. Moreover, I would argue that this type of approach overestimates the capacities that authoritative actors have in managing the complexities of the tasks involved. For instance, in Global South conditions, given the complicated and often ad hoc nature of policymaking, the reliance on consistent and capable actors could be challenging for TM. As such, TM would be unsuitable for this thesis because the tools provided lack with the means to open up the analysis on the regime. It may be helpful in creating conditions for regime shifts, but the focus for my research is to make a more in-depth analysis of why and how regime shifts do occur.

2.1.3 Choosing MLP as the framework

Transitions are inherently complex phenomena to study because there are relationships amongst multi-actors along multi-dimensions (markets, regulations, cultural, social movements, infrastructure and social legitimacy) over an extended period of time (Geels and Schot, 2010, p. 96). Moreover, this research is concerned with the diffusion of technologies, their sedimentation into background structures and processes which may unlock regimes. Thus, the MLP is an appropriate framework to use.

Moreover, MLP scholars suggest that a heuristic device which guides an analyst in identifying patterns and underlying mechanisms is more appropriate than simple cause and effect models (Geels and Schot, 2010; Geels, 2011).

There are primarily three ways in which the MLP is best suited to the current research:

- First, the MLP appreciates the co-evolutionary nature of socio-technical change; therefore, various theoretical roots (economic and social considerations) are mobilised that can trace patterns and regularities over time. In this regard, the MLP is open to interpretive frames, such that a researcher is able to analyse alignment and linkages amongst different processes across temporal changes.

- Second, the MLP uses a narrative explanation which describes outcomes as 'event sequences, and timing and conjunctures of event-chains' which helps to 'capture complex interactions between agency and changing context and changing identities' (Geels, 2011, pp 34-35).

- Third, the causality in a narrative explanation is considered as 'probabilistic', and there is a need to describe 'twists and turns' of certain events (Geels and Schot, 2010, pp 95-99). Here, the MLP strength is that it helps to organise case studies as structured according to landscape, regime and niches. However, it is acknowledged that specific patterns or the speed of a particular transition are dependent on local contexts. Therefore, the generalizability lies in the degree to which the MLP is applicable in various local cases (Geels and Schot, 2010, p. 95). The greater the applicability to various empirical cases, the more chances there are in enhancing the exploratory power of the MLP's concepts. This is only possible if further local cases are tested, examined and interrogated. It is this call to which the South African case studies aim to contribute.

Having identified the MLP as my framework, I now move the discussion towards regime lock-ins, which are fundamental concepts to this research.

2.1.4 Regime lock-in

Much of the current literature on path dependency and lock-in pays particular attention to bottom-up emerging radical innovations that might displace these resistant incumbents (Smith et al., 2010; Unruh, 2000). In an analysis similar to Dosi (1982) on the notion of 'technological trajectories', Geels (2011) and Unruh (2000) point out that established technical competencies can be inflexible in a way that limits innovation to

incremental and predictable changes in firms. This means that regime actors may have preconceived ideas and beliefs about the relevance of new technologies concerning fit, form and compatibility within an existing system. For technologies, lock-in can occur because economies of scale favour adoption and increased learning effects as evidenced by the often used example of the QWERTY keyboard (David, 1985). The QWERTY keyboard is an example of long-lasting technological path dependency, because the design achieved a dominant market position early on, leading to economies of scale and crowding out alternative designs that followed. This example elucidates how, once an initial choice gets locked in, a change is challenging even if there are more efficient technologies available (Thelen, 2003).

Moreover, another lock-in mechanism is due to regulatory mechanisms that enable the status quo and sunk investments in infrastructure, as well as extended lifetime capacity (Penna and Geels, 2012; Geels, 2011). For socio-technical systems, increasing returns can be mutually reinforcing through a process of co-evolution of technologies, shared mindsets and regulatory institutions (Foxon, 2011) (Table 2.1). Consequently, these lock-in mechanisms indicate that innovation is incremental, with predictable technological trajectories. Therefore, the regime is the source of inertia which radical innovation needs to overcome. In the MLP conceptualisation, radical innovation takes place at the niche level.

Table 2.1 Sources of industrial regime lock-in, adapted from (Geels, 2014a; Unruh, 2002)

Lock-in	**Examples**
Technological	Dominant design, standard technological architectures and components, compatibility
Shared mindsets, cognitive frames	Routines, preferences, blinding actors to development outside their focus, cognitive schemas
Industry	Industry standards

Regulatory institutions	Government policy, legal frameworks, departments

After this description of the regime, the discussion will now turn towards the current gaps of the regime in the literature.

2.1.5 Regime critiques in the literature

One of the critiques of the regime relates to its interpretation as a monolithic or homogenous bloc (Smith et al., 2005) which fails to account for internal tensions, conflicts and incoherencies (Fuenfschilling and Truffer 2014; Smith et al., 2010; Holtz et al. (2008). These micro fluctuations may not be accurately depicted because a regime is assumed to be a unified block that faces pressures from the outside, such as niche innovations and landscape developments. In response to this assumption, Geels (2011) indicated that regimes operate within semi-coherent rules, which do allow for tension, conflict and disagreement amongst rules from different regime dimensions (Geels, 2011). Moreover, he noted that it might be helpful to understand regimes as having 'coherence, shared rules and similarity' and simultaneously 'containing variety, disagreements, debate and internal conflict' (Geels, 2011, p. 31). In this regard, Geels (2011) stresses that such conceptualisation would require an empirical analysis to strengthen the argument.

Second, regime behaviour is another stream of research in transitions literature that has gained prominence. Regime behaviour relates to the idea that, instead of understanding regimes as having automatic stability due to routinised norms and practices, there are scholars in the field who see regimes as actively resisting change (Geels, 2014b), as well as shaping regime rules through an institutional process (Genus, 2012; Fuenfschilling and Truffer, 2014; Smink et al., 2015), a reorientation towards radical innovation (Berggren et al., 2015; Penna and Geels, 2015) and engaging in multiple regime interactions (Raven and Verbong, 2007; Sutherland et al., 2015).

Third, a collection of research is termed the 'flipside' of transitions, in reference to how old regimes are weakened or destabilised or deliberately phased out, creating space for

new regimes to emerge and become established (Turnheim and Geels, 2012; Turnheim and Geels, 2013; Kivimaa and Kern, 2016; Kern and Rogge, 2018). For instance, Turnheim and Geels (2013) conducted a historical study of the British coal industry that indicated that destabilisation was at first slow, hindered by regime inertia lasting a few decades, but gradually changes in user preferences, technological competition and a decline in market position over time ultimately led to the demise of the UK coal industry.

Fourth, some ST scholars argue that theoretical and conceptual frameworks developed in the Global North will likely encounter challenges when applied in Global South contexts (Hansen et al., 2018). These scholars assert that countries in the Global South tend to have higher levels of political and economic instability, greater social inequality and rely more heavily on informal institutions (Wieczorek, 2018; Hansen et al., 2018; Sengers and Raven, 2014). For example, 'informal' transport in Bangkok is the dominant form of mobility, and it is often unregulated and lacks proper public sanction because of rampant socio-spatial inequalities in the city (Sengers and Raven, 2014). Others have noted the undemocratic nature of regimes due to the continuation of rent-seeking activities in South Africa's renewable energy sector (Swilling et al., 2016). Moreover, Wieczorek (2018) has raised research questions on whether there is a continuum of regime stability from monolithic to hybrid configurations and the need for nuancing regime characteristics in the Global South context.

Similarly, van Welie et al. (2018), examined the sanitation sector in Nairobi, Kenya using the regime concept. These scholars have also iterated that, in a developing country context, there is a highly uneven distribution of infrastructure and complexity of essential services. In this work, they identified five different types of service regimes, all of which have their own unique set of characteristics depending on social fitness and spatial configuration. They concluded from their research that a 'splintered' regime, with weak alignment amongst the different types of services, represented the Nairobi sanitation sector. They stressed in their work that understanding the differences between cohesive and fragmented regimes allows for a better understanding of complex arrangements within regimes, and therefore, policies such as city and service planning are better able to address societal challenges.

2.1.6 Opening up the regime

One of the ways to open up the analysis on regime stability and change to a more useful enquiry is by drawing on the central crossover theoretical positions in the MLP – evolutionary economics and interpretivism (Geels, 2010) (Table 2.2). In socio-technical change, evolutionary economics focuses mainly on firms and the market in which actors behave in a boundedly rational way, using routines and standard operating procedures to solve everyday problems (Dosi, 1982; Nelson and Winter, 1982). Conversely, interpretivism provides a constructivist approach to shared interpretations and meanings. Here, a solution to problems is realised through debate, discourse and sense-making (Geels, 2010). Using both of these theoretical positions, ST scholars developed a quasi-evolutionary approach that helps explain the socio-technical change that is inclusive of sociological dimensions (Rip and Kemp, 1998). They assumed that socio-technical change is filtered through variation (not only through firms' competition but also expectations and social fitness), selection (markets with social, cultural and political dimensions), and retention (behavioural learning, as well as interpretive and strategic deliberation of institutionalisation) (Geels, 2010).

Both theoretical positions are essential in the MLP because the assumption is based on creative actors as knowledgeable agents who are embedded in regimes (Geels, 2010). Moreover, both have a fundamental focus on process and development over time (Geels and Schot, 2010; Geels, 2010). Therefore, while evolutionary economics is focused on 'technological trajectories' (Dosi, 1982), the MLP does allow the space for cognitive learning which emphasises reflection and learning from experiences (Geels, 2010). Relatedly, Geels (2010) noted that a radical change is possible through a cumulative endogenous process such as second-order learning in cognitive frames.

Table 2.2 A crossover of theoretical positions within the MLP: evolutionary economics and interpretivism (Geels (2010)

Theoretical positions	Default orientation	Explanation of transitions
Evolutionary economics	Dynamic stability (incremental change) and radical change (niches)	Exogenous changes in selection pressures
Interpretivism/constructivism	Ongoing change	Radical change through an endogenous process in second-order learning (change in cognitive frames)

To develop these ideas, I have therefore drawn on an interpretive approach in strengthening an endogenous institutional theory with which to observe the process of regime change. In socio-technical transitions, a growing number of researchers have turned to institutional theory in analysing the regime (Andrews-Speed, 2016; Geels et al., 2016; Smink et al., 2015). For instance, Fuenfschilling and Truffer (2014) used insights from institutional theory to argue that the rigidity and strength of a regime can be determined by the degree of structuration, which is due to the process of institutionalisation of its core elements.

2.1.7 Using Institutional theory to analyse regime changes

Building on institutional theory, Fuenfschilling (2014) suggests that the regime is described as a highly institutionalised socio-technical structure, and that regime stability is dependent on actors who are capable of strategic deliberation and interpretation of rules in an organisational field. Fuenfschilling (2014) goes on to assert that the degrees of institutionalisation or coherence of structures present in a socio-technical system can offer information on the probabilities that change may take place. For this statement,

she conceptualised agency as part of an institutional work, whereby regime actors either engage in the creation, maintenance or disruption. In other words, the Fuenfschilling (2014) approach provides a way to analyse the interplay of structure and agency in socio-technical change.

In a similar effort, Smink (2015) also used institutional theory to analyse incumbents' role in STs. Furthermore, Smink highlighted that incumbents that are traditionally part of the fossil fuel system could slow down the introduction of new (opposing) technology through institutional work, thereby limiting the pace at which STs could unfold. Here, institutional work meant that incumbents would emphasise the disadvantages of new technology and use media channels to enlist the support of the public by, for example, arguing that the new product is insufficient. Smink (2015) expected that institutional maintenance work is a feature of incumbents that aim to protect the status quo (Smink, 2015, p. 18). Similarly, new entrants or niches are likely to enact an institutional work of creation (for example, institutional entrepreneurship) or disruption (Smink et al., 2015).

There is also Lockwood et al. (2017) who used historical institutionalism as a way of understanding positive feedback in politics which caused inertia in transitions. Here, feedback could relate to the ways in which existing institutional arrangements, such as governance settings, transparency and inclusivity in decision-making, and the importance of discursive context were all critical factors that may either hinder or accelerate transitions.

Some researchers have elaborated the idea that different institutions can introduce variation regarding the strength of incumbents and how their interests are served, as well as the tendency of policy and regulatory process captured by elite groups (Lockwood et al., 2017, p. 8). For example, the UK had long-established ties to a centralised electricity system after the Second World War. This institutional arrangement enabled the concentration of large utility incumbents in the hands of a few after the liberalisation of the sector. As such, the distribution of powerful elites is confined to a small number of incumbents, and therefore highly exposed to capture by the interests of the elites, with changes likely to be incremental (Lockwood et al., 2017).

This can mean new entrants have considerably higher barriers to overcome and making changes in their favour is far more complicated.

Conversely, Germany is one of a few countries that had a radical shift in sustainability transitions, partly due to a historically sympathetic tradition to environmental movements (Andrews-Speed, 2016; Geels et al., 2016). However, it is essential to note that transitions can shift between pathways of incremental change such as 'fit and conform' or radical pathways such as 'stretch and transform' (Geels et al., 2016; Smith and Raven, 2012). Thus, transitions are dependent on continuous battles amongst actors over preferences for technologies and policies, as well as learning that can occur over time (Geels et al., 2016, p. 900). An example is that Germany, as stated, may have had rapid growth in renewable energy (RE) deployment, but recent problems of system integration caused by intermittent RE has resulted in incumbent utilities fighting back (Geels et al., 2016). In this way, (Geels et al., 2016) have argued that Germany's energy sector is shifting from radical to incremental transitions.

Institutional theory has long informed the development of the MLP and the regime concept in general and also low-carbon energy transitions (Geels, 2004b). Relatedly, Geels (2004b) used a combination of neo-institutional theory, evolutionary economics and science and technology studies (STSs) to enrich the understanding of dynamics in socio-technical systems. Likewise, the socio-technical regime in the MLP drew heavily from institutional theory regarding rules, which provide 'deep structure', where structures are both the context and outcome of actions (Geels, 2004b; Geels, 2011).

However, regime stability and change are understudied topics in transitions research. It is assumed that regime stability is an interplay between structure and agency in which change is brought about by exogenous events in the form of punctuated equilibrium (Geels, 2002). Yet, this understanding has been criticised for failing to give an account of a clearer operationalisation of the regime concept (Genus and Coles, 2008; Smith et al., 2010).

The work of Fuenfschilling (2014) and Smink (2015) using institutional theory has advanced the regime concept. Yet, there are still some limitations because it reinforces the idea of the sharp distinction between regimes enacting reproduction and niches as

the source of innovation. These assumptions fail to account for instances when regimes could also drive innovation at the niche level (as previously described in Section 2.1.5 with Berggren et al. (2015), or when regime actors could potentially engage in undermining their own institutions as part of the institutional disruption process. Therefore, instead of assuming ideal types of regime responses to various mechanisms of institutional work, it is essential that the kinds of effort or response by the regime in its reaction to external and internal pressure become an empirical point of analyses. Notably, this thesis argues that a punctuated equilibrium approach of understanding regime changes limits the value of analysing internal regime responses to shifting core rules as it plays out during a transition.

To analyse endogenous regime changes, I maintain Fuenfschilling and Truffer, (2014) work on using institutional theory in delineating regime stability as levels of structuration and degrees of institutionalisation. Hence, I reasoned that an institutional turn would thus be an essential approach for this research.

Using an institutional approach, there are two groups of ideas. The first is institutional reproduction, which describes how institutions traditionally homogenise into stable structures and thus emphasise stability and continuity. The second is related to institutional change, which focuses more on agency, deliberate strategy and interpretation of rules. These are discussed in the subsequent sections.

2.2 Institutional reproduction

This section begins by stating that parts of the theoretical foundations of the socio-technical regime, which include evolutionary economics and neo-institutional theories, as suggested, have an inherent bias towards processes of stability and conformity. Later, in Section 2.3, the discussion will be extended towards the evolved concepts of the regime, which draw on institutional change. In this way, there is a distinction between the understanding of a regime that subscribes to path dependency, lock-in and inertia, at the centre of regime stability – towards calls for differentiating regime stability as levels of structuration – and degrees of institutionalisation (Fuenfschilling and Truffer, 2014), thereby opening it up to analysis which explains how change may develop in regimes.

Institutional reproduction refers to the notion that institutions are conservative forces that guide actors into homogenous entities and are therefore better at explaining stability, continuity and persistence. The replacement of old technologies by new ones in the MLP has been premised on path dependence and punctuated equilibrium (Geels, 2004b). For example, from a transition perspective, path dependency has been informed particularly from evolutionary economics, which assumes that incumbents conform to pressures derived from the market as part of a competing selection environment. Here, the emphasis is on adaptation through routines, standard operating procedures as the basis for decisions and search heuristics that are close to existing capabilities (Geels, 2011, p. 263). Due to a shared pattern of routines and capabilities amongst industries, these then aggregate towards 'technological trajectories' (Dosi, 1982). Hence, there is an emphasis on mechanisms dealing with increasing returns and positive feedbacks. Fundamentally, positive feedback is understood as some action that is rewarded such that there is an incentive for repetition. Pierson (2004) indicated that the initial choice of technology could get locked in, making it hard to change even under conditions where the competing technology is more efficient. Changes in path-dependent systems are assumed to occur endogenously and incrementally, which is in line with institutional adaptation, whereas abrupt radical changes are exogenous (a form of punctuated equilibrium) which results in institutional discontinuity (Mahoney and Thelen, 2010, p. 8). Consequently, path dependency and punctuated equilibrium create a biased view of regimes as monolithic and homogenous blocks subject to external radical change. Moreover, these assumptions tend to describe regime stability as having an automatic logic (Geels, 2014b).

Similarly, the regime is complemented with sociological mechanisms and processes, for instance, neo-institutional theory, which widen the selection environment beyond market terms. However, the neo-institutional theory has been criticised as being too deterministic, treating actors as 'culture dopes' that naturally conform to institutional pressures, and being better at explaining continuity and stability than change (Geels, 2011, p. 265).

Following on from these criticisms is that path dependency is problematic because increasing returns and feedback are more 'helpful in understanding institutional

resilience than institutional change' (Streeck and Thelen, 2005, p. 6). Moreover, institutional analysis has shown that institutions do change while appearing to show stability, or not change while there is an exogenous shock (Pierson, 2004). Thus, assuming change that originates exogenously can overlook change occurring endogenously. As Mahoney and Thelen (2010) reason, there could be internal institutional reconfigurations during times of apparent stasis or stability. Applying these criticisms to transitions research and supposing change as exogenous to the regime, there is then a tendency to underestimate endogenous regime changes, which could point out how spaces open up for niches to successfully breakthrough.

Considering the value of endogenous regime change, it would be helpful to understand the process of institutionalisation further, as this research can then suggest the ways in which change may transpire. In the following sections, there will be a discussion on the *processes of institutionalisation* and the *types of pressures that* influence the outcomes of institutionalisation.

2.2.1 Process of institutionalisation

Conventional institutional theories conceptualise firms which operate in an organisational field, and these, in turn, are influenced by their institutional environment (Dimaggio and Powell, 1983). Moreover, an organisation field is the selection environment which places organisations in similar institutional settings, such that their structuration is deemed similar or 'isomorphic' (Dimaggio and Powell, 1983). According to Dimaggio and Powell (1983, p. 148), an organisational field is composed of 'establishments that are recognised in society, and these include key suppliers, resource and product consumers, regulatory agencies and other organisations that produce similar services or products'

Fuenfschilling (2014) noted that the process of institutionalisation usually follows three mechanisms in increasing order of alignment, coherence and stability. These are habituation, objectification and sedimentation. Habitualisation is a process whereby innovation is localised within a small group of actors, whose activities are unstable and uncoordinated. At this stage, there is no precise alignment of values, user practices or social legitimacy. The second mechanism is objectification, whereby actors engage in

problem definition, framing and solving, to the extent that the public recognises and justifies a need for change (Tolbert, 1999). Lastly, sedimentation is the full institutionalisation in both breadth and depth, such that the formation of the structure is perpetuated for an extended period (Fuenfschilling and Truffer, 2014; Tolbert, 1999). The notion of sedimented structures is especially important, as it qualifies the research interest of the socio-technical regime. These obdurate structures pave the way for systems which are locked in and highly path dependent.

2.2.1.1 Three types of rules

Essential in this process of institutionalisation is the endogenous organising and coordinating principles of rules, of which there are three types: regulative, normative and cognitive (Scott, 2014) (see more in Appendix D). Regulative rules refer to laws imposed by standards, regulations and legislation (Geels, 2014a). Normative rules refer to values, behavioural norms and role expectations. Lastly, the cognitive frames are belief systems, guiding principles, goals, mental maps and search heuristics. The cognitive rules are regarded as deep-seated because these are taken for granted, and actors are usually unaware of the genesis of their foundations (Geels, 2014a). It is the process of alignment and embedding of these rules within society, as well as their ongoing reproduction and enactment, which leads to the creation of structures (Geels and Schot, 2010). Moreover, Fuenfschilling (2014) asserts that the degrees of institutionalisation or embedding of rules reflects the levels of structuration in a given system, and this, in turn, has consequences for the stability of the regime. In applying these views to socio-technical research, the strong embedding of rules is reproduced or demonstrated by the following: (1) scale and scope of diffusion of practices, (2) historical embedding of institutions, (3) coherence and (4) impermeability to social resistance (meaning the acceptance of rules to the point where they are taken for granted and as ‘coercive fact’) (Fuenfschilling and Truffer, 2014; Penna and Geels, 2012; Genus and Coles, 2008; Geels, 2011).

2.2.2 Different types of pressures that influence institutionalisation

The second part of institutionalisation is what Dimaggio and Powell (1983) indicated as consisting of different types of pressures which influence institutionalisation towards

homogenisation, in the direction of increasing compatibility to its external environment, which they referred to as 'isomorphism'. In other words, since actors operate within an institutional environment that has prevailing pressures placed upon them, the assumption is that structuration is deemed similar or 'isomorphic' (Fuenfschilling and Binz, 2018). Dimaggio and Powell (1983) specified three types of institutional pressures which influence direction towards isomorphism or homogeneity. These are the following: (1) coercive isomorphism, related to formal and informal pressures exerted on organisations due to expectations by society brought on by government mandates and regulations, (2) normative pressures, related to professional expectations such as conditions and methods of work and lastly, (3) mimicry, which is where organisations imitate or copy others that are successful in order to eliminate uncertainty and minimise complexity. The implication of isomorphism is that organisations are rewarded for their resemblance to others because there are certain benefits, such as legitimacy, respectability and accrued political power (Dimaggio and Powell, 1983). Therefore, institutional isomorphism makes it difficult for established organisations to change, and it creates a high barrier for new entrants to overcome.

A combination of organisational isomorphism with discursive institutionalism has also shown how institutional reproduction could also be established through ideologies, interests and its interactions with both formal and informal institutions. For example, Kern (2011) demonstrated the interplay of discourses, institutional contexts and interests in shaping institutional outcomes and also established the interaction of discourses, institutional contexts and interests in shaping policy initiatives in low-carbon policy programs in the Netherlands and the U.K. Kern (2011) had shown that discursive interplay amongst actors was influenced by informal (e.g. norms, habits and customs) and formal institutional rules (e.g. laws, regulation, standards). Kern (2011) established that, when UK civil servants associated with climate change programmes that had long-standing beliefs in the importance of free-market competition and market-based approaches, they preferred market solutions for a low-carbon economy. Conversely, in the Netherlands, when civil servants had a culture of open service, with a tradition of collaboration amongst the state, consultants and researchers, this led to the emergence of transitions that were supportive to experimentation on new ideas about future

policies (Kern, 2011). Kern (2011) also mentioned that the translation of new narratives faces daunting challenges when it confronts dominant discourses which are embedded in robust institutional arrangements. He concluded that analysing the relationship between new discourse against existing interests and institutions is a systematic way of explaining the sort of changes that may lead to moderate policy or radical changes.

In this brief account of the process of institutionalisation towards homogeneity, a question is posed on how change can occur. According to Garud et al. (2007), privileging structure could lead to overly deterministic models, placing primacy on reproduction, stasis and continuity. Likewise, it is essential how we are able to understand regime change, given the literature on path dependency and punctuated equilibrium is better at explaining stability than change. Relatedly, a question raised by institutional scholars is the notion of how actors can change the very institutions which have conditioned them (Battilana and D'Aunno, 2009). To elaborate on this, the next section turns its focus to institutional scholars who are interested in change, tension and conflict (Greenwood and Hinings, 1996). In doing so, the research begins to uncover insights that could be suitable in appreciating the dynamics of regime change.

2.3 Institutional change

To discuss institutional change, it is essential to draw on several authors who pay considerable attention to the role of agency, tensions and conflict (Mahoney and Thelen, 2010; Greenwood and Hinings, 1996; Oliver, 1991). There is, for example, Oliver (1991) who referred to ‘active agency’ where organisations engage in ‘acquiescence, compromise, avoidance, defiance and manipulation’. Likewise, Greenwood and Hinings (1996) distinguished that institutional change could be analysed by considering the internal dynamics of organisational interests, values, power dependencies and capacity for action. Similarly, Oliver (1992) described how organisational entropy could eventually lead to gradual acceptance that some institutionalised practice is no longer valid (a process she called dissipation), as well as the outright rejection of the established organisational practice.

Institutional change is also influenced by the conditions in an organisational field as these have consequences on how actors respond to changes. These conditions can

include the plurality of institutions, as different institutional arrangements are likely to have more competing interests and motivations. There are also the conditions of uncertainty, which are closely associated with the degrees of institutionalisation (Fuenfschilling, 2014). Fuenfschilling (2014) has asserted that during times of uncertainty, the strategic action is to recover towards stable, secure and predictable norms. Alternatively, the greater the uncertainty or de-institutionalisation, the more likely there is scope for an agency in a direction towards institutional change.

Overall, institutional change necessitates a form of distributed agency (Garud et al., 2007), in which actors are not 'cultural dopes' or passive rule followers, but are 'knowledgeable agents' that can reflect and engage in ways other than their taken for granted social rules (Geels and Schot, 2010, p. 30). A distributed agency means an agency that is dispersed within the structures that actors themselves have created (Garud et al., 2007). Lawrence et al. (2011) highlighted that there is a potentially large number of actors in an organisational field, and therefore distributed agency means a set of coordinated and uncoordinated efforts, which can lead to institutional change. Thus, structures can be constraining features on actors in which they are embedded, but also a platform for enabling activities. Moreover, actors could draw on their structures, through deliberate strategy and interpretation of rules (Geels, 2014a). The distributed form of agency suggests that altering the formal, cognitive and normative rules can lead to a transformation in the social structure (Garud et al., 2007). Here, a useful description of different types of agency that leads to institutional change is Hall and Thelen (2009) description which includes: (1) reform (institutional change explicitly directed or endorsed by the actors), (2) defection (when actors no longer adhere to existing rules) and (3) reinterpretation (when the actors enact or interpret existing rules differently).

Additionally, Geels and Schot (2010) specify that, by incorporating agency, actors go beyond routine base actions, whereby learning, anticipation, and deviating from existing norms are conceived. Hence, variation is not blind but directed, because some room for creative interpretation by actors is included (Geels and Schot, 2010), thus conceiving of agency as 'embedded', where actors either try to maintain the status quo through the reproduction of rules or as 'distributed', which is when there is the capacity to deviate or disassociate from the established rules.

As one of the ways of understanding why there is an agency that leads to institutional change in the first instance is the seminal work by Pierson (2004), who expanded on path dependency beyond economic terms. He stressed that institutions are also subject to increasing returns due to political feedback. He claimed that political systems are subject to dominant groups, which can enhance the asymmetries of power. Likewise, he recognised that there is a slow-moving causal process (cumulative causes, threshold effects and causal chains) which does not conform to the widely accepted theory on punctuated equilibrium. Implicitly, institutions are not automatically locked in, nor do they stand still; instead, continuity is a constant mobilisation of resources (Sorensen, 2014, p. 28).

Broadening these insights further are institutional scholars Streeck and Thelen (2005) and Mahoney and Thelen (2010), who offered different perspectives on how institutional change may occur. In reassessing the assumption of the punctuated equilibrium model, Mahoney and Thelen (2010) viewed 'change as a constant search or flux', and therefore implied that institutions do not reach an optimum. Instead, a progressive form of change over time is posited, as opposed to abrupt or wholesale transformations (Mahoney and Thelen, 2010). Moreover, rather than accept a sharp distinction of change between institutional reproduction and innovation, an alternative is that 'stability is just anomaly' (Sotarauta and Pulkkinen, 2011, p. 106).

What is also helpful with Mahoney and Thelen (2010) approach is characterising institutions as 'distributional elements laden with power implications' (p. 8). This means institutional outcomes can be reflective of powerful groups that have designed institutions according to their own needs, or constitute differing goals due to 'ambiguous compromises' (Mahoney and Thelen, 2010, p. 8). Hence, power and authority through public institutions are relevant sources of positive feedback.

Further, assuming institutions as path-dependent takes for granted reinforcing features of institutions. However, in reality, institutional outcomes are due to compromises or continuous negotiations and, as such, are susceptible to shifts in distributional power (Mahoney and Thelen, 2010). In other words, power and agency are important in explaining both continuity and change in path dependent process (Mahoney and Thelen, 2010).

As Thelen (2003) stated, there is a need for better conceptual tools that can capture institutional evolution and change.

Here she asserts that:

> . . . introducing somewhat more structure at the "front end" of institutional development . . . and injecting more agency and strategy at the "back end" is a way of actors responding to changes in the political and economic contexts.
>
> (Thelen, 2003, p. 6)

In sum, reconciling both institutional reproduction and institutional change relates to the classic debate on the 'paradox of embedded agency' (Garud et al., 2007; Battilana and D'Aunno, 2009). The paradox of embedded agency refers to questions raised by institutional scholars of how actors can change the very institutions which have conditioned them (Battilana and D'Aunno, 2009). In other words, if actors are embedded within an organisation field, subject to rules that structure their perceptions, interests, and characteristics, how would they be able to imagine alternative realities, practices and norms? (Garud et al., 2007). The next section discusses the notion of 'duality' as part of Giddens (1984) work on addressing this paradox.

2.4 Structure and agency

In attempts to address issues of agency and structure, we must consider Giddens (1984) work on duality wherein the structure is both a medium by which actors use and an outcome of social practices. Duality, as defined by Giddens (1984) is that structures are considered as 'rules and resources' which guide but do not determine action. Moreover, actors are not 'cultural dopes', but are preferably those who interpret and enact rules, which then lead to variety during the instantiation of rules. Rather than separating theory between agency and structure, Giddens (1984) argues that both are inextricably linked. Therefore, embedded structures may constrain actors in consigning them to maintaining institutions but may also offer them fertile ground for institutional change.

Here, it is essential to note that, for the MLP, rather than being in between two different positions of structure and agency, the regime is considered as dual in nature (Geels and Schot, 2010; Geels, 2011; Svensson and Nikoleris, 2018). Thus, Geels and Schot (2010) recognised Giddens (1984) structuration theory as being useful in the MLP because of

the discerning feature between actors and social systems versus actors and social structures (Figure 2.1). These distinctions provided the contextual embeddedness by which actors operate, whether horizontally (in social systems) or vertically (in social structures). To clarify, the vertical component concerns actors drawing on structures that pertain to formal, cognitive and normative rules (Geels and Schot, 2010), while the social system is a concern about the mutual dependency amongst actors, described as trying to build 'seamless web' that aligns heterogeneous elements into a configuration that works (Geels and Schot, 2010, p. 53). Thus, the attention is a horizontal view between the interactions of actors with social systems and the contestation, exchange and negotiation it entails.

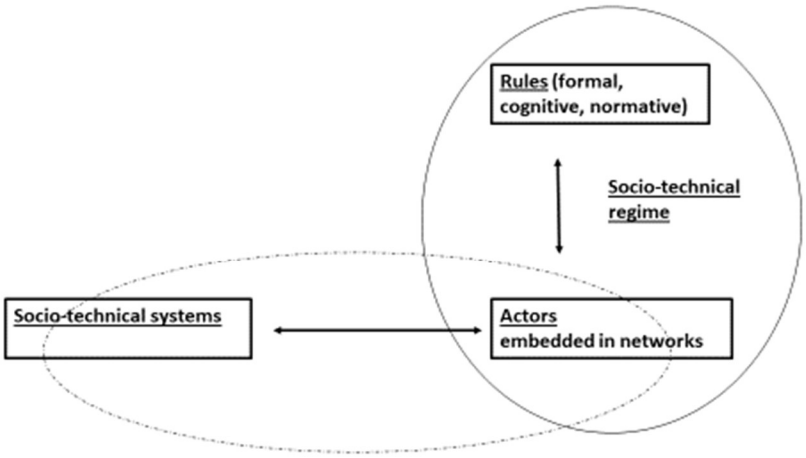


Figure 2.1: The underlying theories that constitute the MLP, adapted from (Geels and Schot, 2010).

The reasons why these distinctions are helpful is that the regime can be understood as the relationship in how actors draw upon their structures, and the ways in which those structures are expressed in the socio-technical system. Primarily, the structure in the regime exists due to instantiation and reproduction of rules in routines and practices (Geels and Schot, 2010). Thus, contextual embeddedness is a crucial component for this thesis because it locates the research interest on actors and social structures.

Discussing these concepts of structure and agency, as part of understanding the dual nature of the regime, becomes essential in constructing my conceptual meta-framework.

2.5 Summary of the chapter

This chapter has discussed the theoretical positioning of the thesis by highlighting the current gaps in the existing ST literature related to regime stability and change. Essentially, the research puzzle is how changes in structure can reveal the ways in which a regime maintains stability. Therefore, the focus is on actors drawing on rules and resources, and the various efforts related to regime stability and change. Moreover, despite the given understanding of the regime as dual in nature, there is still a lack of nuance in the relationship between endogenous regime changes and niche opportunities. To address this gap, Chapter 3 develops a conceptual meta-framework that problematises regime stability into parts which enable scrutiny and analysis. It does so by mobilising concepts related to the dual nature of the regime and institutional theory as it helps to focus the analysis on the rules that provide the stabilising features of regimes.

CHAPTER 3

CONCEPTUAL META-FRAMEWORK

3.1 Introduction

Having discussed in Chapter 2 the multi-level perspective of sustainability transitions and problematised the notion of regime stability and change, this chapter focusses on developing a conceptual meta-framework for bringing together the insights from the case study Chapters 4, 5 and 6. The conceptual meta-framework draws on Giddens (1984) structuration theory on duality, in which structure is both a medium by which actors use rules and resources and an outcome of social practices. Moreover, it builds on Fuenfschilling and Truffer (2014) work on characterising regime stability as levels of structuration and degrees of institutionalisation. Their study operationalised the regime as a highly institutionalised socio-technical structure, and the regime's stability is considered dependent on actors, who are capable of strategic deliberation and interpretation of rules in an organisational field.

In this chapter, I first discuss the foundational concepts of an organisational field, the distinction between homogenous and heterogenous actor network composition, followed by the notion of actors as rule-makers versus rule-takers, and lastly the difference between rules and institutions. I then develop a conceptual meta-framework for characterising regime stability and change in terms of structure and agency. Following this, the chapter introduces the three case studies, discussing how each contributes to our understanding of regime stability and change. The chapter finishes with a summary of the conceptual meta-framework.

Organisational field

An organisational field includes a community of actors that interact with each other to produce similar services or products (Dimaggio and Powell, 1983). In an organisational field, the understanding is that the institutional environment places prevailing coercive, normative and mimetic pressure onto the community of actors, such that the structuration of activities is deemed similar (Fuenfschilling and Binz, 2018). It is this structuration that leads to trajectories or pathways resulting in lock-in. This research considers the community of actors to include businesses, suppliers, producers, user groups (households, industries), societal groups (civil society) and public authorities (e.g. regulators, national ministries) (Geels, 2004a).

Homogenous and heterogeneous actors

This research considers a network composed of a homogenous set of actors as having similar ideas, preferences, interests and values in maintaining a coal-fired electricity regime. This would, for example, include a network of public authorities (national ministries), civil society (trade unions), and market-based actors (energy intensive users groups, such as Eskom, as well as mining and associated industries). Likewise, a network composed of a heterogeneous set of actors is one which has different preferences other than coal and can include market actors, such as IPPs, civil society (climate change advocacy groups) and public authorities (regulators, national ministries amongst others).

However, it is essential to note that interests and preferences by actors are not rigid, but can change over time (Geels, 2004a). It is often the case that actors are driven by self-interest, such that their strategies or actions change in pursuit of improving their position and control over resources (money, market, power, social legitimacy) (Geels, 2004a). A way of understanding how actors' preferences or interests may change is the notion of rule-makers and rule-takers as outlined in institutional theory.

Rule-makers vs rule-takers

This research recognises that rules of socio-technical regimes account for the main stabilising and lock-in features of socio-technical systems (Geels and Schot, 2010, p. 20). Therefore, the interpretation is that changes in rules reflect the dynamism of regime

stability and change. Moreover, it is the expression of those rules in a system, in what Geels (2011) considers 'tangible' (artefacts, market shares, infrastructure, regulations, consumption patterns and public opinion), which is essential for this research. Given that the stability of the regime is dependent on the continual reproduction of rules and practices' this also means it is subject to ongoing mediation between motivated actors. Therefore, a focus on rule changes can be a useful way of analysing regime stability and change.

Transition researchers do acknowledge that the MLP is a 'quasi-evolutionary' approach whereby 'actors anticipate, give meaning, search, and can deliberately deviate from existing routines and rule regimes' (Geels and Schot, 2010, p. 30). Furthermore, Geels and Schot (2010) indicated that regimes become unstable when actors begin to diverge from and disagree on basic rules. This disagreement in rules in the regime can be a source of change when tension arises, such as a mismatch between different types of rules, or actors begin to have different ideas, preferences, values and interests (Geels and Schot, 2010, p. 44). To develop these ideas further, a systematic analysis of what changes in rules could mean for regime stability and change is posited.

For this, a turn to scholars of endogenous institutional theory, such as Streeck and Thelen (2005), is helpful because they recognise that regimes typically consist of rule-makers and rule-takers who are embedded in society (Figure 3.1). Conceptually, in this way, there is a level of play or interpretation in how rule-takers act upon rules. Rule-takers do not objectively implement the rules, but some of their activities may modify them, or they may merely implement them differently in respect to their originally intended purpose. Institutions, amongst other things, are constituted by actors with 'divergent interests, varying normative commitments, different powers and limited cognition' (Streeck and Thelen, 2005, p. 16). Hence, power and agency are essential in explaining both continuity and change in path dependent process (Mahoney and Thelen, 2010).

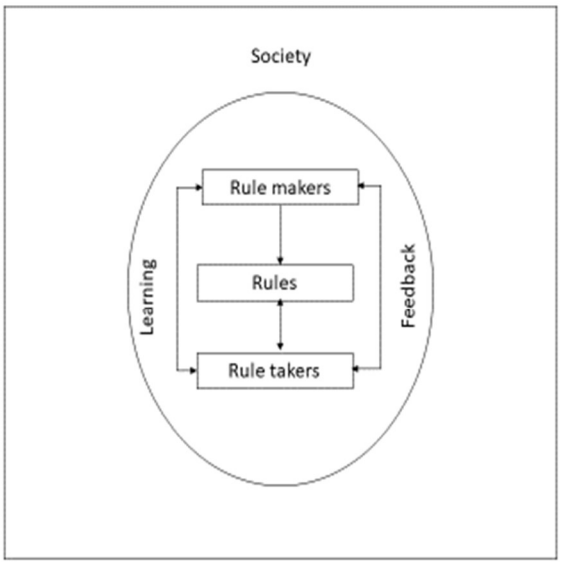


Figure 3.1*:* Illustration of rules-makers and rule-takers, adapted from Streeck and Thelen (2005).

Expanding on these concepts, I propose that a relationship between rule-makers and rule-takers needs to include feedback and learning loops, such that a dynamic process ensues. At this point, learning would mean that actors, over time, familiarise themselves with rules associated with the regime. In this way, there is an inherent variation between rules as they are created and their implementation over time. According to Mahoney and Thelen (2010), rules are vague and ambiguous, and therefore they are an essential source of 'critical openings for creativity and agency'. There is also a feedback loop, whereby rule-makers could adjust the rules depending on how they are instantiated in practice. Therefore, the process of implementing rules is marked by variability because of 'knowledgeable actors'. In line with Giddens (1984), having knowledgeable actors means that interpretation or compliance with rules can vary over time. Even if a rule is formally codified, there remain "struggles over its meaning, application and enforcement" (Mahoney and Thelen, 2010, p. 11). In sum, this research postulates that analysing endogenous changes in the ways that regime actors maintain, alter, reinterpret and repurpose rules is likely to reveal the dynamics of regime stability and change. To test this assumption, I discuss in Section 3.4 four modes of institutional changes derived from Streeck and Thelen (2005), and these refer to drift, layering, conversion and displacement. Coming from the political sciences literature, these

concepts describe different types of institutional changes. However, I adapt and apply these concepts to analysing rule changes which follow Scott (2014) normative, regulative and cognitive rules.

Rules vs institutions

It is essential to qualify the differences between rules and institutions. This research is in line with ST scholars who define rules as the underlying deep structures in regimes, as earlier stated in Chapter 2. Examples of these are cognitive (engineering beliefs, heuristics, rules of thumb, routines), regulative (standards, laws, policies) and normative (social expectations, values) (Geels and Schot, 2010). These rules are endogenous organising and coordinating features which guide the behaviour of a set of actors in a socio-technical system. The appreciation is that these rules are embedded in a socio-technical system. Examples are found in artefacts, market shares, infrastructure, regulations, consumption patterns and public opinion (Geels, 2011). It is the process of embedding and expression of these rules and the ways in which they are widely diffused and adopted by a broad section of society that creates an institution (Schot and Kanger, 2018).

In sum, this research places the MEC in an organisational field, where the coal-fired electricity regime represents the highly institutionalised structure in the field where Eskom is the dominant incumbent. Moreover, the organisational field constitutes a community of 'knowledgeable' actors who act as rule-makers and rule-takers who can change ideas, preferences and values depending on the field conditions. Given these foundational concepts, the next section develops a conceptual meta-framework, that problematises regime stability and change, in terms of structure and agency, preserving the notion of 'duality of the regime'.

3.2 Problematising regime stability and change

3.2.1 Structure

My aim of problematising regime stability and change is to develop an analytical separation between structure and agency. In the MLP, the structure is necessary because each analytical level represents different degrees of stability and practices. As

such, niches have limited structure because there is a high degree of uncertainty and fluidity, and networks are small and unstable (Geels and Schot, 2010). Niches are protective spaces wherein actors can experiment with new routines, alternative visions and ideas, which diverge from the norm (Smith and Raven, 2012). Conversely, regimes are considered more stable than niches because routines are embedded in more extensive systems of organisation, networks and infrastructures. Thus, the degree of embeddedness (embeddedness can mean sedimentation of structures in institutional fields, political cultures and networks) in a regime provides its durability, predictability and limits to incremental change (Grin et al., 2010). At the landscape level, this represents the broader exogenous environment, which is outside the direct influence of the regime and niches (Geels and Schot, 2010). Examples of the landscape level are climate change, urbanisation, demographic changes, wars and globalisation (Svensson and Nikoleris, 2018; Geels and Schot, 2010).

Structure is essential in the MLP because regime stability or instability can shape the opportunities for niche development (Raven, 2005). Regime instability does not automatically mean there are opportunities for niche development. This is because the timing of interactions between the regime and niches is important (Geels and Schot, 2007). The presumption from the MLP is that regime destabilisation needs to occur in order to create opportunities for niches. However, Raven (2005) indicated that differentiated regime stability should instead be recognised as comprising three separate parts. These are high (I), limited (II), and low regime stability (III) (Figure 3.2). This means low regime stability does not necessarily mean more opportunities for niche development. At some point, this relationship becomes paradoxical, where too much regime instability causes a decrease in niche opportunities.

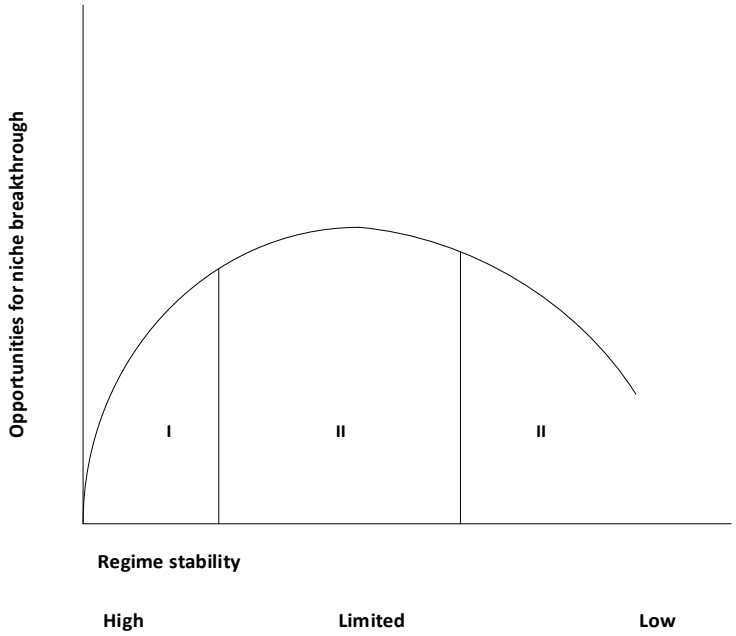


Figure 3.2: The relationship of regime stability and niche development (Raven, 2005).

According to Raven (2005), it is limited regime stability that offers the best opportunities for niche development because the incumbent is forced to look for solutions during challenging times. Furthermore, the shared rules and resources that pertain to network relations, regulatory frameworks and market rules are still intact (Raven, 2005, p. 271). In this regime condition, actors are seeking solutions outside their own environments, and this provides resources for niches to draw upon for development.

Conversely, low regime stability is unfavourable to niche development because there is too much uncertainty, and regime actors are no longer aligned in the search for heuristics or shared visions under this challenging condition. Equally, in this situation, the technological base is too diversified, and hence the associated regulatory framework does not exist, nor are user preferences or clear markets. Therefore, the bottom-up change of niches overcoming regimes described in the MLP may not be as clear-cut as portrayed. Instead, a period of shared resources between regimes and niches may coexist until technology takes off and becomes dominant over time. In line with this theoretical hypothesis, Verbong and Geels (2010) offered an empirical example to support Raven (2005) postulation in the case of biomass gasification in India. In this work, it was noted that a large upscaling of biomass gasification had required a limited level of regime stability because clear understandings of grid conditions, as well as user preferences and investor certainty, where needed.

Using Raven's (2005), differentiated regime stability approach, I developed various forms of structure relative to regime stability. To conceptualise structure in this study, it was essential that I attended to Giddens (1984) definition of 'rules and resources'. The rules referred to are based on Scott (2014) cognitive, normative and regulative frames. Rules are embedded in society along the dimensions of technology, user practices and the market, techno-scientific knowledge, policy, infrastructure and socio-cultural aspects (Geels, 2004a). From an institutional perspective, the embedding process creates a highly institutionalised socio-technical structure, which is the regime (Fuenfschilling, 2014). The greater the institutionalisation, the stronger the structure of the regime. Resources refer to economic, knowledge, social and political means, which have an influence on how actors deliberate on strategic decisions (Geels and Schot, 2010). For example, some actors have more access to money, information, organisational and social capital and political power, which enables them to maintain their interests.

The idea is that actors are embedded in these structures, but also reproduce them because it is through instantiation and reproduction of rules in practice that structures are created and maintained. Hence, it is for these reasons that structures are dual in nature, being both a medium and an outcome of an action (Geels and Schot, 2010). Importantly, for this research, actors draw upon their rules as knowledgeable agents to make sense of their world, and in doing so, some variety is created in local practices. In the work of Fuenfschilling (2014), she asserted that the degree of institutionalisation or embedding of rules reflects the levels of structuration in a given system, and this, in turn, has consequences on the stability of the regime. This thesis builds upon these theoretical foundations, but the aim is to further develop the 'dual' nature of the regime. There are three levels of structure according to different regime stability. These are the following:

- Strong: close alignment of rules, along with the availability of sufficient resources (of various kinds), provides a strong structure to enable actors to maintain their current practices, routines and relations, in pursuit of their shared interests.

- Moderate: when there is disagreement in rules amongst the regime actors and resources begin to decline, thus leading to a moderate structure.
- Weak: when there is substantial incoherency in rules such that regime actors are no longer aligned, and resources are not readily available, and thus a weak structure is postulated.

Next, I define different types of agency corresponding to levels of regime stability.

3.2.2 Agency

In this research, agency is defined as the capacity of actors to express action through routines, habits, the imagination of possible alternatives of the future and practical judgement of ambiguous or constantly evolving circumstances in the present (Emirbayer and Mische, 1998). Applying these concepts to my research, there are two factors which may influence the type of agency that emerges relative to the stability of the regime, and these are: (1) the conditions of the organisation field, and (2) the actor network composition and the strength of actor coalitions.

The conditions of the organisational field have an influence on actors in recognizing the features of the rules that are either constraining or enabling (Fuenfschilling, 2014; Battilana and D'Aunno, 2009). For example, there could be disturbances such as changes in economic or socio-political environments (e.g. changes in user preferences, increasing competition, normative contestation in social movements, power struggles and adoption of new laws), or there could be a crisis in the field which emerges from an extreme event (e.g. wars, environmental disasters [Geels and Schot, 2010]), all of which create uncertainty (Turnheim and Geels, 2013; Geels and Schot, 2007). Thus, field conditions impact on actors' preferences, behaviour and responses to corresponding changes (Battilana and D'Aunno, 2009).

In terms of actor network composition and the strength of actor coalitions (Geels et al., 2016), plausibly, if the actor composition is homogenous, then the actors are likely to be involved in the reproduction of the core rules of the regime. If the actor composition starts to become heterogeneous, such that there are new actors in the field, who have different interests and preferences and may not agree on the core rules of the regime,

then this can be a source of contradictions and competing alternatives, ideals or norms, which, in turn, undermine the reproduction of the rules in the field.

3.2.2.1 Multi-dimensional types of agency

To conceptualize the types of agency, which may emerge relative to the stability of the regime, some assumptions must be recognised. The MLP approach accepts that transitions are dependent on three factors: (1) different social groups, (2) actors who can change their preferences, interests and identity during transitions, and (3) explanations which require the tracing of twists and turns, the alignment of event sequences and trajectories (Geels and Schot, 2010, p. 95). From this perspective, it is possible to have multiple types of agency, where there are varieties of rational, routine and interpretive action during a transition (Geels and Schot, 2007). The multiple types of agency proposed by Geels and Schot (2007) surprisingly lack further application, given that, in a recent article by Schot and Kanger (2018), the nature of the relationships amongst structures, rules and resources, or 'duality', remains unclear in ST research. Building on these ideas, this research conceptualises different types of agency in relation to different levels of stability of the regime. According to the work of such institutional scholars as Battilana and D'Aunno, (2009) and Hall and Thelen (2009), there are four types of agency related to regime actors which are conceptualised: maintenance, reform, reinterpretation and defection.

- Maintenance: when actors enact the type of actions which relate to the reproduction, repairing and defending as part of maintaining existing rules.
- Reform: considered a highly visible form of change because it is explicitly endorsed or mandated by governments.
- Reinterpretation: enacting the existing rules differently.
- Defection: the abandonment of existing rules because those rules might no longer work to promote actors' interests.

3.2.3 Three different forms of regime stability

I now characterise regime stability into three forms, which are high, limited and low, taking into consideration structure and agency (Table 3.1).

Table 3.1*:* Characterising regime stability into high, limited and low, with various forms of structure and agency

Structure	Agency	Stability of the regime
Strong	Maintenance	High
Moderate	Reform	Limited
	Reinterpretation	
Weak	Defection	Low

High stability of the regime

Strong structure

When there are coherent or aligned rules – those of a taken-for-granted character (deep structures, such as cognitive routines which make actors blind to options outside their focus), normative rules (broad consensus amongst a population or group of actors over shared rules) and regulative ones (e.g. legally binding contracts are in place) – the regime structure is considered strong (Geels and Schot, 2010). Moreover, if the resources that include economic (e.g. dominant market position), social legitimacy and power distribution remain intact and are amenable to the regime actors, then this contributes to strong regime structure. Thus, with rules aligned and resources available for maintaining the status quo, the regime can appear to show a strong structure.

Agency

Where field conditions display high degrees of certainty or institutionalization, they contribute to high regime stability. In this field condition, rules are clear and coherent,

in such a way that it leads to regular patterns of practices and routines (Geels and Schot, 2010).

Moreover, when there is alignment amongst regime actors over the regime rules, it is assumed that shared common goals are present and that there are vested interests in maintaining the status quo.

Therefore, with field conditions that are certain, and regime actors aligned, it is likely that regime actors are associated with *maintaining* the core rules of the regime.

Limited stability of the regime

Moderate structure

If there is disagreement in the core rules of the regime, then it is likely that the structure of the regime begins to be uncertain or moderate. For example, if the embeddedness of specific institutional arrangements begins to disentangle (Fuenfschilling, 2014), then the structuration influences, such as cognition, coordination or guidance over regime actors, may start to decline.

Agency

When there are disturbances in the field, which include changes in economic or socio-political environments, or a crisis brought about by extreme events or internal accumulation of regime tension over time, these may elicit a response by regime actors.

There could also be an increasing heterogeneity in actor composition in the organisational field, which can disrupt the alignment between regime actors. This has an effect on changes in expectations amongst the regime actors, as well as introducing varying interests and ideas at play, which can lead to tension, conflict and disagreement over the core rules of the regime (Geels and Schot, 2010).

Under an increasing plural set of actors and uncertainty in the organisational field, according to Fuenfschilling (2014), actors will work strategically – using their diagnoses of the causes of disturbances and their risk evaluations – to try to recover stability. If the patterns and trends are identified, and if the risks can be evaluated, the type of agency could involve *reform*, which is an active endorsement for change by the government

(Hall and Thelen, 2009). Reform is considered a minor modification of existing institutions to improve problems in the organisational field (Streeck and Thelen, 2005). For example, if there are issues in the regime that are perceived as risks to societal needs, policymakers may introduce new regulations that establish performance standards that cannot be met by the existing technology (Geels and Schot, 2010). If there are more significant structural weaknesses, regime actors could be forced to *reinterpret* existing rules differently. The assumption here is that, with more significant structural weaknesses, there is then more uncertainty in the field conditions. As a consequence, *reinterpretation*, compared with reform, is considered a higher degree of disassociation from established practices, routines, and core assumptions. In these instances, regime actors gradually change their interpretation of the regime rules and, thus, its practices, without defecting from or dismantling the existing rules (Hall and Thelen, 2009).

Low stability of the regime

Weak structure

There can be further shifts or changes in rules such that regime actors continue to deviate and differ over the core rules. There are also a reduced flow of economic resources (e.g. market relevance), loss in social legitimacy (e.g. political and public support) and weakening in the endogenous commitment of firms or industries (Turnheim and Geels, 2012), which taken together can make it difficult to reproduce the core elements of the regime, leading to a weak structure.

Agency

When field conditions continue to have a substantial level of uncertainty, such as an ongoing regime crisis, or exogenous changes, such as climate change or urbanisation impacts on the regime, then actors could enact existing rules differently.

Where regime actors are no longer aligned in search of heuristics or a shared vision of the regime core rules, the technological base can become too diversified (for example, in the South African case, diversity could mean many types of electricity generation resources, such as solar, wind, biogas, nuclear, coal and hydro), and hence the associated regulatory framework would perhaps not exist, nor would user preferences (Raven, 2005). Moreover, when there is a proliferation of different types of actors, there

is a likely chance that there are more competing interests, perceptions and motivations, as well as a lack of trust in existing technologies. Therefore, in a combination of complex field conditions, such that it is difficult to anticipate or predict the risks and further variety of actors into the field, some actors may start to *defect* or abandon the core regime rules (Hall and Thelen, 2009).

Summary

Moving forward, by means of conceptualizing regime stability according to different forms of structure and agency, retains the notion of duality as accepted in the MLP. The plausibility of this conceptual meta-framework is evaluated against empirical evidence presented in Chapters 4, 5 and 6. To do so, the rationale for the three cases is as follows (Figure 3.3). Chapter 4 helps explain the establishment of rules and the resources needed for creating the coal-based electricity regime. This demonstrates the kind of obdurate structure that the electricity regime became over time. The subsequent papers then analyse how the regime responded to the changes in rules (Chapter 5 and 6). Following this rationale, there are two theoretical frameworks that I use for the three papers (Figure 3.3). The first paper uses discursive intuitionalism to analyse the establishment of the MEC and the significance of the electricity regime in the country (Chapter 4). Then, using endogenous institutional theory, the next two papers examine the type of regime changes that emerge when the country introduces renewables (Chapter 5) and gas (Chapter 6), described as niches, respectively. In doing so, analysing both the establishment and changes to the regime should provide rich theoretical and empirical insights into the ST literature. The next section discusses the first framework developed for Paper 1.

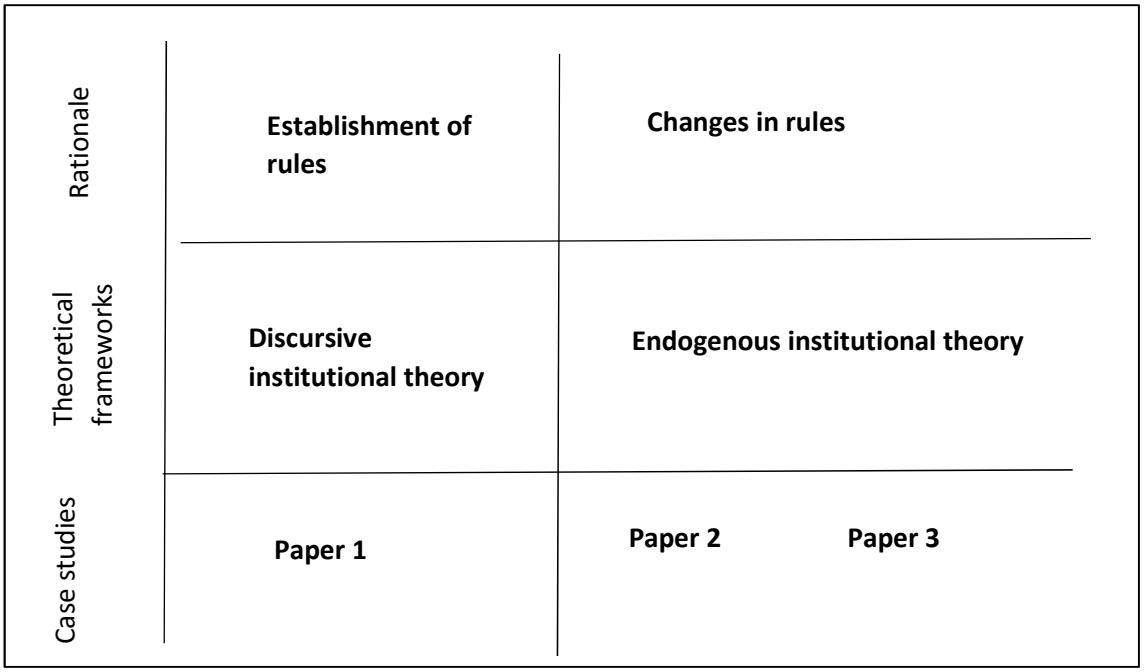


Figure 3.3: The theoretical frameworks used relative to the three papers in this thesis.

3.3 Paper 1: Analysing the establishment of the regime: discursive institutionalism

Some ST scholars argue that theoretical and conceptual frameworks developed in the Global North will likely encounter challenges when applied in the Global South context (Hansen et al., 2018). In this regard, a few scholars have noted the complexity and higher forms of uncertainty that are found in Global South conditions (Ockwell et al., 2018; Wieczorek, 2018; Swilling et al., 2016; Baker et al., 2014). In line with these perspectives is the call for more research that pays attention to the dynamics of power, politics and agency (Ockwell et al., 2018; Wieczorek, 2018; Swilling et al., 2016; Baker et al., 2014).

Drawing on insights from political economy, Geels (2014b) differentiated views of power that span material, institutional and discursive forms. For example, a long-term coalition between policymakers and businesses with a broad consensus from civil society can form a powerful hegemonic bloc. The assumption is that a hegemonic bloc is able to assert dominance through the coercive and bureaucratic authority of the state (Swilling et al., 2016; Levy and Egan, 2003) and establish market position with industrial elites, along with generating and reproducing leading storylines or narratives as a form of the

'best story' (Kern, 2011, p. 1119), which key actors draw upon to influence potential solutions in a specific direction (Bosman et al., 2014).

There are also examples of broad institutional power that is embedded in political cultures, ideology and governance structures (Geels, 2014b). South Africa's case regarding the MEC is an example which has institutional power, wherein the government privileges powerful regime actors because they have more capabilities and financial resources, such as Eskom which has a monopoly on the market.

Discursive forms of power are when incumbents hold a privileged position over prevailing ideologies and beliefs amongst powerful elites, maintaining those ideas as accepted norms that structure relevant discourses. Conceptually, core regime alliances are able to set the terms of discourse, as well as how issues are deliberated, negotiated and contested (Geels, 2014b; Schmidt, 2010). Reconciling elements of power, politics, ideology and institutions is *discursive institutionalism*. Discursive institutionalism describes how political and social realities are shaped by the interactive processes of discourse within its institutional context. Discourse can be defined as 'a specific ensemble of ideas, concepts, and categorizations that are produced reproduced and transformed in a particular set of practices and through which meaning is given to physical and social realities' (Hajer, 1995, p. 56). Discursive institutionalism is helpful because it makes use of how ideas are articulated, considered and disputed through a political arena by state actors, social movements and the public (Schmidt, 2010).

As will be later discussed, the South African government has a strong ideological stance that the electricity system is an essential means of delivering on its socio-economic objectives. Historically, this has meant cheap and affordable electricity using coal as the dominant resource, in order to sustain mining activities in the country, as part of its industrial and economic developmental plans (Fine and Rustomjee, 1996). As such, changes in the country's electricity system, both past and present, are often entangled in ideological mismatches between the actors associated with the MEC and those actors which foresee alternative options (Eberhard, 2007; Segatti and Pons-Vignon, 2013; Fine, 2010).

Relevant for this research, discursive institutionalism seems an appropriate framework to analyse the historical establishment of mining and energy in the case study. Paper 1 is expected to contribute to our understanding of regime stability and change in South Africa's coal-fired electricity regime. It does so by using discursive institutionalism to describe how ideologies, interests and institutions established the rules and the resources needed for creating the coal-based electricity regime. Paper 1 examines how the structure of the electricity regime became established over the period from the 1920s until the present day. During this time, the state ensured that resources were put in place, such that energy policies promoted the interests of the MEC by establishing Eskom and by providing government incentives, tax subsidies, and import substitution to foster the mining and energy-intensive industries and a labour market that had a steady supply of low-cost labour (Makhaya and Roberts, 2013; Roberts and Black, 2009). Consequently, the coal-fired electricity regime became a highly institutionalised structure, with various amenable resources that enabled its dominance. Paper 1, therefore, provides a contextual preamble, relative to the kinds of pressures placed by the two niches of renewables and gas in subsequent papers.

3.4 Papers 2 and 3: Analysing changes in the regime through endogenous institutional theory

Taking into consideration that there is variability in how rules are enacted between rule-makers and rule-takers over time, the different types of rule changes developed by Streeck and Thelen (2005) become helpful. In the next section, the four different institutional modes of change clarifying how the assumptions built into these will be applied to analyse regime stability and change.

3.4.1 The four modes of institutional change

The following discusses drift, layering, conversion and displacement, developed by the original authors Streeck and Thelen (2005), Mahoney and Thelen (2010) and Hacker et al. (2015).

Drift occurs when regimes hold onto existing rules, by resisting or refusing to adapt to changing circumstances. This may result in the system ceasing to function the same as it had previously (thus the term drift) (Hacker et al., 2015). This may seem counter-

intuitive for drift actors not to respond when its rules are becoming irrelevant, thereby yielding a risk towards insignificance and decline. However, actors that seek drift are trying to avoid public debate so that they can try to persuade governing actors to maintain existing rules, without having to deal with contesting views. Hacker et al. (2015) note that, with drift, change is not achieved with an 'electoral spectacle' nor with 'big legislative battles'; instead, contestation is fought with less scrutiny, away from public sight and through quieter, less prominent channels. This is because clashes in highly visible spaces have the potential to spark initiatives that could lead to mobilisation of competing interests.

Moreover, Hacker et al. (2015) indicated that the abilities of actors that seek change through drift are very much different from those who are outside the incumbents' inner domain. Here, drift actors tend to possess insider knowledge, insights and views across numerous arenas for a much more extended period (Hacker et al., 2015). The point of drift is that by delaying and shifting the contestation into hidden channels, the opposition actors are unable to gain sufficient knowledge to mobilise efforts against the incumbents, such as forming coalitions, articulating contesting narratives or provoking public protests.

For this example, Hacker et al. (2015) noted that the US minimum wage, which is not indexed to inflation, could decline in value over time unless new federal legislation is enacted. Drift here would mean blocking the updating of existing rules despite the need to do so. This means that refusing or deliberately neglecting to update an existing rule to reflect the environment can cause the system to drift.

Layering is one of the concepts most developed by Streeck and Thelen (2005) and is defined as the addition of new rules alongside an existing one. Here, an example would be the introduction of the private pension system in the US within an existing welfare public system. Furthermore, the private pension was implemented as a voluntary alternative and, importantly, did not attack or directly undermine the existing system. Eventually, the private pension system grew to such an extent that the old system started to lose support from key constituencies, and ultimately, this led to its stagnation (Streeck and Thelen, 2005).

The assumption in layering is that adding a new rule means that it causes ‘path altering dynamics’, whereby the new rule eventually crowds out the old, which could end up declining over time (Streeck and Thelen, 2005, p. 23).

Conversion defines institutions as ‘multipurpose tools’, which means they can be used for differing ends, depending on who is powerful enough to utilise them in their favour (Hacker et al. (2015). Conversion occurs through actor discontinuity ‘because actors that were not involved in creating the original rules now seek ways to repurpose them for their own interests’ (Hacker et al., 2015, p. 184). The mechanisms here are the redirection of the institutional resources over political or other forms of mediation and contestation over what functions and purposes an existing institution should serve. In other words, existing institutions are redirected into new goals or purposes according to those who are powerful enough to do so.

An example is the British Labour Party which came to power in 1945 and which inherited several policy instruments because of wartime emergency measures (Hacker et al., 2015). Here, the policy instruments were not dissolved but instead redirected to serve new goals, which were to serve peace. The instruments were used to strengthen the role of the state through the power of redistributing wealth. Hacker et al. (2015) go on to mention that conversion, in this case, was a strategy used to emphasise continuity to enlist the support of those who were already vested in existing institutions, as well as to neutralise those who were opposed to sudden changes, resulting in political feasibility or expediency.

Displacement is the removal of an old institution, through radical or gradual replacement over time (Mahoney and Thelen, 2010). This is the least developed concept, and Thelen mentioned that displacement is ‘rare in the politics of reform in contemporary advanced capitalist economies’ (Thelen 2009, p.488). Moreover, in large technical systems, wholesale displacement from old to new has also been claimed as exceptional, given the long duration of path-dependent systems (Sovacool et al., 2018). I, therefore, suggest possible means of displacement, drawing on increasingly important literature, such as phase-out policies (Rogge and Johnstone, 2017), creative destruction (Kivimaa and Kern, 2016) and ‘discontinuation governance’ (Stegmaier et al., 2014).

These four different types of rule changes are summarised in Table 3.3, which outlines their definitions, mechanisms of change and their implications.

Concluding this section

To conclude this section, Papers 2 and 3 cover three of the institutional theory modes (drift, layering and conversion), and each paper will be discussed in more detail in turn. The fourth mode is not covered by any of the papers but is included in the discussion and conclusion chapter, where that discussion builds on the findings from Papers 2 and 3.

Paper 2 draws on institutional modes of drift and layering to illuminate the types of institutional changes which are evident when a relatively stable regime (with a strong structure that enables actors to maintain their current practices) is subjected to pressures from a niche.

Paper 3 contributes to the discussion on regime stability and change by analysing the kind of institutional changes which take place when a regime that has limited stability (disagreement in core rules amongst regime actors, leading to moderate structure) faces further pressure when a gas programme is introduced into the electricity system.

3.5 Summary of the chapter

In sum, this chapter has explained how the main concepts used for this thesis are mobilised in order to address the research task. In doing so, a conceptual meta-framework was developed, which problematises regime stability into three forms: high, limited and low (Table 3.2). In delineating these three different forms, structure and agency were used as a way to maintain the notion of the duality of the regime. Having differentiated regime stability, I am then able to test these concepts by means of the empirical cases, using institutional theory as a lens through which to observe endogenous regime change. The next three chapters form the empirical case studies in this thesis, and their purpose is to establish how the coal-fired electricity regime was established (Chapter 4) and to provide an analysis of regime responses to the introduction of renewables (Chapter 5) and gas (Chapter 6).

Table 3.2: Summarises regime stability and change as differentiated levels of structure and agency

Structure			**Agency**			**Stability of the regime**
Rules	**Resources**	**Type of structure**	**Organisational field conditions**	**Actor network composition and strength of coalitions**	**Type of agency**	
Coherent	Resources are intact and amenable to actors	Strong	Certain	Homogenous Coalition is strong	Maintenance	High
Disagreement	Reduced flow of resources	Moderate	Uncertain patterns and trends are identifiable; risk can be evaluated	Heterogenous Coalition is disentangling	Reform	Limited
Disagreement	More reduced flow of resources		More uncertainty	Heterogenous Coalition is disentangling	Reinterpretation	
Incoherent	Substantial loss in resources	Weak	Substantial level of uncertainty; it becomes challenging to anticipate or predict the risks	Complex set of actor configurations, competing interests, perceptions and motivations Coalition is weak	Defection	Low

Table 3.3: The four different types of gradual transformation of drift, layering, conversion and displacement, adapted from Streeck and Thelen (2005)

	Drift	Layering	Conversion	Displacement
Definition	Rules are deliberately held constant in the face of significant contextual shifts.	New rules are added alongside existing ones; New rules do not attack existing institutions.	Redeployment of old institutions to new purposes.	Removal of existing rules and replacing them with new ones.
Mechanisms of enactment	Deliberate neglect or delay in reforms.	Involves amendments, revision or addition.	Gaps between rules and enactment due to subversion; existing rules are reinterpreted.	The existing rules are abandoned, as they are not tenable.
Institutional outcome	Continuity is attempted through hidden channels to prevent the mobilisation of opposing interests.	The new rule sets path altering dynamics, which can result in more significant impact of new institutions at the expense of the old.	Existing institutions are repurposed, redirected into new goals.	A displacement of the old institution with the new.

CHAPTER 4

Paper 1: Historical review of the relationship between energy, mining and the South African economy

This has been published as TING, M. B. 2015. Historical Review of the Relationship between Energy, Mining and the South African economy. *In:* MYTELKA, L., MSIMANG, V. & PERROT, R. (eds.) *Earth, Wind and Fire: unpacking the political, economic and security implications of discourse on the Green Economy.* Johannesburg: Real African Publishers.

4.1 Abstract

Mining, energy and industrial development have been crucial to growth and development in South Africa. It is estimated that South Africa's mineral wealth value is around $2.5 trillion (GCIS, 2012, p. 4). Mining and the electricity industry co-evolved together due to the abundance of inexpensive coal. The electricity industry was spurred by the needs of a flourishing mining industry around the beginning of the twentieth century. South Africa's electricity industry is embedded in what is known as the Minerals-Energy Complex (MEC). The MEC is described as the relationship between mining, energy-intensive mineral processing, the coal-to-electricity sectors, and parts of the supportive transport and logistics infrastructure (Fine and Rustomjee, 1996). However, the continued reliance of South Africa's electricity system on coal is increasingly under threat from international pressure to mitigate climate change. Additionally, sustained dependence on a resource-based economy is risky, not only because of finite supply but, more importantly, because an emphasis on a global commodity market renders the economy vulnerable to short-term volatile capital flows, and less long-term labour absorbing economic growth. The main objective of this chapter is to discuss how South Africa faces the challenges and demands towards sustainable transitions.

This chapter first provides a brief overview of South Africa's mining and energy and the need for sustainable development. After which, the underlying theoretical derivatives and framework are discussed. Subsequently, it centres its discussion on interest, ideas, and institutions. It will analyse how policies, discursive narratives and vested interests related to mining and energy have previously interacted and currently interact, effectively creating barriers for the innovation of more sustainable technologies.

As a way forward, a discussion takes place on a proposed implementation for sustainable mining and energy that includes: the necessary requirements to adequately capacitate the socio-technical systems that govern and implement mining and energy developments; continuous monitoring and evaluation once policies are implemented; understanding the concept and implications of carbon lock-in given the long-term life span of energy expansion; and meta-coordination of strategy implementation. Lastly, a recommendation for further research is given on shifting from a resource-based

economy towards a knowledge-based economy. South Africa needs to go beyond beneficiation. Instead, it should expand the process underlying the knowledge in obtaining these minerals and use it to diversify or enhance other sectors of the economy. These could include technological innovation in the mechanisation process, machineries, parts, tools and equipment – all of which could spill over into essential sectors such as transportation, information technology, construction, and manufacturing.

4.2 Introduction

South Africa initially built its economy on two major primary sectors: mining and agriculture. Mining has been the foundation of South Africa's industrialisation and later the financialisation of the economy. Over time, mining, energy and industrial development have been crucial to growth and development in South Africa (McDonald, 2009; Winkler and Marquard, 2009; Gentle, 2009). It is estimated that South Africa's mineral wealth value is around USD $2.5 trillion (GCIS, 2012). A term to describe a tight configuration of industries associated with mining is often called the Mineral Energy Complex (MEC) (Fine and Rustomjee, 1996). The MEC is described as the relationship between mining, energy-intensive mineral processing, the coal-to-electricity sectors and parts of the supportive transport and logistics infrastructure (Fine and Rustomjee, 1996). Despite the recent years of the poor performance of the mining sector, mining continues to be an essential part of the South African economy, and this is unlikely to change for a few decades. South Africa has many strategic minerals of global importance.

South Africa's mining history and its relevance to its economy can be traced as far back as the discovery of diamonds in Kimberley in 1871 and the Witwatersrand main gold reef in 1886. The wealth of its mineral resources is evident with one of the largest reserves of Platinum Group Metals (PGMs), chromium, gold, manganese (high-grade ore), alumino-silicates, vanadium and other minerals in the world Table 4.1. In addition, the mining sector has also been a source of other competencies such as engineering, technical and production expertise, and broad research and development activities. Most of South Africa's mineral wealth is exported as ores, concentrates, alloys or metals with some degree of beneficiation downstream. The exceptions are iron and steel, as well as polymers from oil and coal, which are used as inputs into the manufacturing

sectors (ANC, 2012). As depicted in Table 4.1, the mineral wealth reserves in the country have a long lifespan and are expected to continue to play an essential role in the country.

Table 4.1: A summary of South Africa's mineral reserves and their relative global production percentages (ANC, 2012).

Mineral	Unit	RESERVES			PRODUCTION 2009			LIFE
		mass	%World	Rank	Mass	%World	Rank	Years
Alumino-silicates	Mt	51	*	*	0.265	60.2	1	192
Antimony	kt	350	16.7	3	3	1.6	3	117
Chromium Ore	Mt	5500	72.4	1	6.762	*	1	813
Coal	Mt	30408	7.4	6	250.6	3.6	7	121
Copper	Mt	13	2.4	6	0.089	*	*	146
Fluorspar	Mt	80	17	2	0.18	3.5	5	444
Gold	t	6000	12.7	1	197	7.8	5	30
Iron Ore	Mt	1500	0.8	13	55.4	3.5	6	27
Iron Ore - including BC	*Mt*	*25000*	*~10*	*	*55.4*	*3.5*	*6*	*451*
Lead	kt	3000	2.1	6	49	1.2	10	61
Manganese Ore	Mt	4000	80	1	4.576	17.1	2	874
Nickel	Mt	3.7	5.2	8	0.0346	2.4	12	107
PGMs	t	70000	87.7	1	271	58.7	1	258
Phosphate Rock	Mt	2500	5.3	4	2.237	1.4	11	1118
Titanium Minerals	Mt	71	9.8	2	1.1	19.2	2	65
Titanium- including BC	*Mt*	*400*	*65*	*1*	*1.1*	*19.2*	*2*	*364*
Uranium	kt	435	8	4	0.623	1.3	10	698
Vanadium	kt	12000	32	2	11.6	25.4	1	1034
Vermiculite	Mt	80	40	2	0.1943	35	1	412
Zinc	Mt	15	3.3	8	0.029	0.2	25	517
Zirconium	Mt	14	25	2	0.395	32	2	35

4.2.1 Mining and Energy

Mining in South Africa and its associated sectors include iron and steel, chemicals, non-ferrous metals, non-metallic minerals, electricity and transport. The mining industry is also essential to manufacturing as it is linked via activities such as minerals beneficiation and metals production (Winkler and Marquard, 2009) as well as backward linkages in mining equipment. Therefore, the contribution of the MEC to the economy cannot be viewed in isolation, nor can it be measured in absolute terms. The largest energy-intensive industrial subsector in South Africa is iron and steel, which consumes around 27% of the total energy used by the industry sector (DOE, 2010). The South African mining and electricity industries co-evolved together due to the availability and abundance of inexpensive coal. The electricity industry was spurred by the needs of a flourishing mining industry around the beginning of the twentieth century (Gentle, 2009;

Winkler, 2009). The major challenge for sustainable development in the context of climate change mitigation lies in the energy sector, which accounts for more than 70% of Green House Gas (GHG) emissions. The share of final energy demand can be distributed as follows: industry (38%), residential (18%), and transport (28%) and other minor contributions (DOE, 2012). Underlying the energy sector is an intensive coal-based system, the result of which is nine tons per capita (tpc) of carbon emissions, rivalling that of Organisation for Economic Cooperation and Development (OECD) countries with an average of 11 tpc (World Bank, 2010). Thus, a case for sustainable energy development in the country is relevant because it is considered to be 'carbon intensive'. The continued reliance of South Africa's electricity system on coal is increasingly under threat from international pressure to mitigate climate change. Furthermore, resource-based economies are subject to finite supply and to global commodity cycles that are increasingly cognisant of trends towards environmental sustainability.

The main objective of this chapter is to provide insights into the barriers in South Africa's mining and energy complex that must be addressed in order for sustainable development to be feasible.

4.3 Framework

The analysis used for investigating the feasibility of sustainable energy development in the mining sector was structured around interests, ideas, and institutions framework The primary theoretical derivative for this framework is drawn from Hajer (1995); Kern (2011); Schmidt (2010) using discursive institutionalism, and Giddens (1984) structuration theory as a means of understanding human social behaviour.

The work of Giddens (1984) on the distinction between three types of structures, all of which influence action through different mechanisms, becomes relevant in this research. He outlined that there are structures of i) signification, where meaning is realised in practice, ii) legitimisation, where normative views are embedded within societal norms and values, and iii) domination, which is about how power is applied. For example, although each structure is applicable across all domains, a legitimisation structure is best suited to a domain pertaining to law, the significance of meaning is

more applicable to culture, and domination is most applicable to economics and politics. Table 4.2 summarises the degree of applicability of each kind of structure against each institutional domain, where the number of plus signs indicates the degree of applicability. This overlap between structuration and the institutional domain is an important schematic approach for my research.

Table 4.2: The type of structures related to institutional domains (Giddens, 1984; Geels and Schot, 2010).

Institutional domains	**Signification**	**Legitimisation**	**Domination**
Economic	++	+	+++
Political	++	+	+++
Law	+	+++	++
Culture	+++	+	++

These three types of structures are then applied to ideas (signification), institutions (legitimisation), and interests (domination), as defined categories by discursive institutionalism (Kern, 2011). *Discursive institutionalism* describes how political and social reality is shaped by the interactive processes of discourse in its institutional context. Discourse can be defined as "a specific ensemble of ideas, concepts, and categorizations that are produced reproduced and transformed in a particular set of practices and through which meaning is given to physical and social realities" (Hajer, 1995, p. 56). Discursive institutionalism is helpful because it makes use of how ideas are articulated, considered and disputed through a political arena by state actors, social movements, and the public (Schmidt, 2010).

The following concepts of ideas, institutions and interests are now defined:

Ideas refer to meaning and signification that is realised in practice. More specifically, it focuses its analysis on discursive narratives, ideologies, belief systems, guiding principles, and mindsets that are related to mining and energy in the country. Empirically, this chapter discusses the structure of the economy related to mining and the role it may play in strategy or policy formulation around sustainable development,

historical availability of cheap coal and its relevance to trade and competitiveness, the recent trends in the uncertainty around the oil price, the Long-Term Mitigation Strategy (LTMS), which has conscientised the efforts needed to lower carbon emissions, and the role of labour and trade unions, which have engaged in essential debates in these and related issues.

In terms of *institutions*, these are socially embedded systems of rules through legislation and regulation. To put it another way, institutions are rules of the game and organisations are players that abide by these rules within a system. It is the interaction between institutions and organisations that configure a socio-economic system. Relevant for this chapter, institutions look at the legislative mandate governing the mining sector that enables the rules of the game; financialisation that serves to strengthen profits and favour the MEC; the role of lobbying and the influence of financial contributions to political parties and, lastly, the essential Integrated Resource Plan (IRP) that determines energy decisions in the country.

The last section is on *interests*, and this refers to domination and how power is exercised. The aim is to investigate influential groups and the power they may have in lobbying issues relative to their agendas. These groups include the powerful MEC sectors, the influential role of the state-owned power utility, Eskom, and continued reliance on coal for energy security.

By discussing these three areas, it is hoped that a holistic argument can be made for clarifying the obstacles for sustainable development in mining and energy in South Africa.

4.4 Ideas

South Africa's mineral wealth is due mostly to its platinum reserves, followed by coal, palladium, gold, titanium, copper and others. The biggest mining companies in South Africa have significant investments within the Johannesburg Stock Exchange (JSE), and these also belong to an Energy Intensive Users Group (EIUG), which collectively (including associated industries such as materials beneficiation and materials manufacturing) account for 44% of electricity demand in the country[10]. Furthermore, mining provides critical foreign exchange via trade exports**;** it contributes around 20% to the GDP (direct and indirect) and is an essential source of jobs in the country. It is estimated that a social multiplier for mining is a ratio of 10 to 1, thus, given the employment of 1.3 million people, the totality of people dependent on the mining industry can be as high as 13 million. The mining sector was built upon a model of high labour and low wages. However, to what extent this will continue in the future remains unclear, not only because of increasing trends towards mechanisation but also because of instability within the labour force and wildcat strikes.

Furthermore, the interlinkages of growing inequality and social unrest cannot be ignored because most miners earn wages that are not adequate to support large families. However, this labour model is historically derived and embedded within the socio-economic framework. It should be appreciated that sustainable energy development is only a part of a complex set of problems that policymakers need to address. The country is experiencing developmental challenges that include widening inequality (Gini-coefficient of 0.6), an unemployment rate of 25%, and slow real economic growth of less than 2% GDP per year (NPC, 2012). Sustainable energy development is part of a much broader set of issues facing the country. To move forward, it is vital for critical decision-makers to realise that some of the underlying issues are rooted within ideologies that constrain progress. The following sections will now discuss key ideological issues.

[10] Energy Intensive Users Group (EIUG), www.eiug.org.za

4.4.1 Coal as the dominant resource

Coal accounts for 70 to 75% of primary energy supply, 93% of electricity generation and 30% of liquid petroleum fuels (Eberhard, 2011; Winkler and Marquard, 2009; Winkler, 2009; Davidson, 2006). Coal production and consumption are intricate parts of the economy. The revenues are derived from a range of activities from export, mining, to the manufacture of synthetic fuels. South Africa has abundant coal reserves, albeit low in quality (high ash content). The low-grade coal has an average of 4,500 kcal per kgash content of 29.5% and sulphur of 0.8% (Eberhard, 2011). The approximated coal reserve stands at 32 billion tonnes, making it the world's largest recoverable deposit (WEC, 2013). South Africa's energy landscape has historically been tied to the strategic needs defined by the government at specific times. Therefore, between 1948 and 1994, the central imperative from the government was energy independence and self-sufficiency (mainly as it grew isolated from the international community due to sanctions and other forms of isolation). Thus, the apartheid government decided to secure its energy supply by utilising the coal to liquids (CTL) process for fuel production, meaning that large quantities of both electricity and fuel are produced from coal: Eskom and the latter by Sasol provide the former. Sasol is the world leader in the processing of coal to synthetic fuels, having started production in the 1950s. It produces more than 40% of South Africa's domestic fuel and contributes 4 to 5% of the country's GDP (Sasol, 2009, p. 4). Coal accounts for more than 90% of the electricity produced in the country; the rest comes from nuclear power stations (5%), hydro and pumped storage (4%), as well as biomass, solar, and wind, which together account for less than 1% (Heun et al., 2010; Pegels, 2010; Davidson, 2006).

Sasol and Eskom have a combined carbon dioxide emission of 300 million tonnes (Mt), which accounts for 67 to 69% of the total GHG output (Sasol, 2010, p. 79; Eskom, 2014, p. 39). Coal is an entrenched regime with influential industrial players that have a considerable role to play in the country's economy. To what extent the country reduces, its reliance on coal is indeed a central issue in terms of barriers to sustainable development. It is this balance between ensuring energy security through its abundant coal reserves, but also through contemporary sustainable practices, which require the least economic trade-offs. However, choosing carbon-intensive pathways that continue

to lock in and reinforce business as usual practices may, in fact, undermine desired developmental goals. Sustainable development can offer ways of diversifying the economy in a manner that is in line with global trends towards greener economies.

4.4.2 The challenge of cheap coal and electricity

The availability of inexpensive coal was critical to the establishment of the mining and electricity industries. The term ‘mineral-energy complex' (MEC) was developed by the seminal study called *The Political Economy of South Africa,* by Fine and Rustomjee (1996). The MEC has fundamentally formed the energy economy of the country, which in turn has a significant role in the energy landscape of the country. The close involvement of the MEC has resulted in the country having one of the lowest electricity prices in the world. It is reported that South Africa’s electricity prices were consistently 40% of the average United States prices for the last four decades (Winkler and Marquard, 2009). Eskom, through its association with the MEC, has taken advantage of large economies of scale in coal mining and power generation. Thus, guaranteed demand meant that favourable contracts could be negotiated over the long term. Furthermore, most of Eskom’s assets relating to electricity generation had been paid off, which means that its expenditure was limited to low running costs. Although South Africa has known since 1997 – as shown in its White Paper on Energy – that an electricity deficit would be reached by 2007, no significant new plants had been commissioned by this time (DME, 1998). Thus, with an ageing electricity infrastructure and lack of maintenance due to low generation reserves, the country has undergone a series of blackouts since 2008. This means that, for a period of seven years, the country has been experiencing an uncertain electricity supply. To mitigate electricity shortfalls, diesel generators have been used at a significant cost. Unfortunately, the country's state-owned power utility has recently faced a series of credit downgrades, and the cost of using diesel has only aggravated this situation and has severe implications for its ability to borrow money for new energy builds.

Cheap coal and cheap electricity have been central to South Africa’s competitiveness. Specific industrial policy has promoted electricity intensive investments such as mineral processing (Winkler and Marquard, 2009). Moreover, special electricity supply contracts

between, for instance, Eskom and BHP Billiton and its aluminium smelters were revealed in 1992, and again in 2001, showing sales at below cost prices (Steyn, 2006). The exclusive deal had effectively tied Eskom to supplying BHP Billiton with cheap electricity for more than twenty years. To this day, these exclusive deals continue to stress Eskom's finances. However, new electricity builds require financing, and the reality of cheap electricity cannot continue. Any adjustments to the dominant paradigm in the electricity sector are bound to have an impact on energy prices, as well as the labour force, and disrupt a valuable source of investment and income for the country. Cheap electricity can no longer be considered for new plants. The present new build programme, irrespective of the sources (coal, nuclear or renewables), must factor in current levelised costs.

4.4.3 Coal and its relevance to civil energy and households

It is important to note that coal not only provides the country with significant liquid fuels, but it is also a means for the government to provide basic energy access. ‘civil energy' has been described as a social development goal by providing energy to households, commerce and services (Winkler and Marquard, 2009, p. 51). Energy is crucial for lighting, cooking, heating, clean water and sanitation, health care, transport, industries and telecommunication. A strong narrative of the post-apartheid government was to address the imbalances of the past by ensuring basic services such as ‘electricity for all’. Almost two-thirds of the South African population did not have access to basic electricity before 1994. The rapid electrification programme resulted in electrification rates that grew from 30% in 1990 to 73% in 2006 (Winkler and Marquard, 2009). Household electricity access and final energy residential demand should not be confused. As referred to earlier, in the context of overall energy demand, the share of residential consumption stands around 15%, but electricity access to the national grid is currently around 70 to 80%.

Thus, post-1994, South Africa had a period where the available electricity infrastructure did not match the rapid growth in demand. At present, the country suffers from a double ‘lock-in' of a high carbon pathway due to the dominance of the MEC, but also its continued reliance on coal for its civil energy. Civil energy is a strong principle for the

government because it is a developmental objective for energy access. Historically, this meant access to grid connection with coal as the primary resource. This carbon lock-in makes it challenging to address issues of sustainable energy development because there are sunken investments, entrenched regimes, and historical vested interests. Thus, in an energy policy setting, it can be appreciated that the complexity of issues has to be carefully considered.

4.4.4 Influence of labour: the role of trade unions

Carbon cycles do not follow political cycles; in that climate change requires a long-term vision. Its effects are anticipated in the medium term, which, though beyond the duration of most politicians' careers, requires immediate action. Hence, the certainty of mitigating options such as renewable energy needs strong arguments to achieve buy-in from sectors that will ensure their implementation. In this respect, one must factor in the influence of members of society and their awareness of the effects and mitigation of climate change. Moreover, people's sentiments equal votes, which cannot be underestimated given that this is the lifeblood of politics.

> … while voters tend to be strongly supportive of the idea of compliance with the international environmental treaties, they can simultaneously be strongly resistant to the reality of higher taxes and energy prices … the political incentives thus can be very different between ratification and implementation of that international commitment …
>
> (Harrison and Sundstrom, 2007, p. 15)

In South Africa, a sector that is influential and important to the vote is that of the trade unions.

> Attending to the issues raised by them will constitute the surest route to electoral success
>
> (Stedman, 1994)

Through the Tripartite Alliance, it is often the case that the South African Communist Party (SACP) and Congress of South African Trade Unions (Cosatu) field their preferred

candidates through the African National Congress (ANC), and consequently hold senior positions in the ANC as well as influence party policy and dialogue (Budeli, 2012). Some influential people hold various positions in one or more of the parties that constitute this alliance. Added to this complexity is that the trade unions emerged mostly from minerals and mining sectors. Hence, their significance cannot be underestimated since it permeates both the political and economic spheres. In addition, hundreds of prominent unionists now play leading roles in institutions of the new South Africa and can influence the broader processes of change that are unfolding. Thus, a formidable group of people from politicians, trade unionists, to business people are all interlinked with each other.

The effects of continued mining strikes in the country are indicative of how intricately the mining sector is embedded in the economy. The five-month platinum strike from January to June 2014 resulted in economic contraction during the first quarter of that year by as much as 0.6%. Mining strikes affected manufacturing, as well as industries that included petroleum, basic chemicals and iron ore (Singh, 2014). Also, tensions within Cosatu and its affiliates have resulted in the exit of the National Union of Metal Workers of South Africa (Numsa), which accounts for an estimated 17% of Cosatu's membership (Letsoalo et al., 2014).

Part of the tension in this regard derives from contestation over economic policy, and this cannot be taken lightly. It can lead to policy formulation that is logical but often hampered at the implementation stages due to the tensions among various actors. Evidence of this is the National Development Plan (NDP), which has ambitious, bold plans for the country and yet seems to be hampered at the level of implementation due, in part, to these tensions (NPC, 2012). As long as these ideological mismatches are not addressed, they will continue to be a source of policy incoherence and implementation inertia.

4.4.5 Uncertain oil price

In a world where the oil price has been assumed to take an upward trajectory, energy investments are decided accordingly. These pertain to new projects in oil and gas exploration and production, as well as renewable energy technologies. Often these

investments are decided based on economic costs mainly associated with the price of crude oil. However, the basis of these assumptions no longer holds, given that between June 2014 and January 2015, the oil price dropped by 60%. Thus, associating energy investments with the prediction of an oil price is becoming increasingly uncertain. Added to this are unpredictable geopolitics, global economic developments, and competing for alternative energy options. Renewable energies are also increasingly on par in terms of economic costs in comparison to new fossil fuel derived plants. A good example is the cost of some solar technologies becoming competitive with natural gas. Again, these expectations may change as the oil price fluctuates. The main point is uncertainty, mainly since there are now more competing energy sources available. Conversely, it has been noted that, despite these uncertainties, the development of flex/fuel engines can provide ways to bypass such ambiguities.

Again, under these conditions, an important balance is needed in choosing the optimal technology that caters to societal needs. South Africa does have vast amounts of coal reserves; potential shale gas in the Karoo region and the Northern Cape is an ideal place for renewable solar plants. Moreover, there are examples of a hybrid solar Photo Voltaic (PV) cell usage combined with diesel engines at a scale of 1 MW being used in Chile and South Africa (Lazenby, 2014). Perhaps a modular approach of hybrid engines comprising solar energy with gas could apply to South Africa given its historical transmission configuration and natural endowments.

4.4.6 Long-Term Mitigation Scenarios (LTMS)

In 2007, the Long-Term Mitigation Scenario (LTMS) project was published, and this landmark project developed various scenarios using energy and macro-economic models to explore the consequences of various policy interventions at reducing GHG emissions (Winkler and Marquard, 2009). The LTMS proposed that the country peak its carbon emissions by 2025, plateau for a decade and then decline thereafter (DOE, 2013a). This process is known principally as ‘peak, plateau and decline’ (PPD), a common phrase in the country’s climate change circles (DOE, 2013a). According to the Department of Environmental Affairs (DEA), the PPD was defined as an upper limit of 428 million tonnes of carbon dioxide (Mt)/per annum in 2050 and a lower limit of 212

MT/per annum CO_2. A scenario in the IRP update was that electricity-derived carbon emissions would peak around 275 Mt/pa CO_2 in 2022, plateau for 10 years, and start to decline around 2034 (DOE, 2013a, p. 26). The decline scenario was either moderate, which would result in reaching 210 Mt/pa CO_2 in 2050 or an aggressive decline that would enable a low limit of 140 Mt/pa CO_2 (DOE, 2013a). However, it is estimated that the two new coal-fired power plants (Kusile and Medupi) and the return to service of three stations mothballed in the 1990s are expected to have a combined coal consumption of over 50 Mt per year, adding more GHG emission in the near future (Rafey and Sovacool, 2011). The LTMS study was critical because it showed clearly the requirements for the country to reduce its future carbon emissions. However, with two new coal plants, and more coal plants envisioned in the future, South Africa's energy policy can be characterised as somewhat contradictory: on the one hand, it promotes sustainable development whilst, on the other, it seems to be increasing its reliance on the extraction and consumption of polluting (and unsustainable) resources.

4.5 Institutions

4.5.1 Mineral and Petroleum Resources Development Act (MPRDA)

Currently, the primary legislative framework for mining and petroleum resources in South Africa is the MPRDA, which is under review. The most relevant section regarding sustainable development pertains to environmental authorisation and management. This section covers cross-cutting issues such as water, environment and licenses to operate. According to the Department of Mineral Resources (DMR), it will designate itself as the Competent Authority for the implementation of the National Environmental Management Act (NEMA) on mining and prospecting sites, and the Minister of Environmental Affairs will be the appeal authority. The DMR has noted that a single piece of legislation implemented across departments will require resources and, more importantly, coordination, particularly in areas of monitoring and evaluation of compliance (DMR, 2013). Coordination is one of the critical issues in implementing policies and strategies in government. This requires inter- and intra-departmental consistent efforts where delineating ownership, responsibility and accountability are paramount. Furthermore, various amendments to the MPRDA do send signals of

legislative uncertainty to the mines on the conditions they should operate in, as well as which policies are applicable. Thus, speedy resolution of these issues, which is a crucial factor in private sector decision-making, is critical.

Adding to this complexity is the need for nexus thinking, where interlinking issues need to be tackled holistically. According to the Mining Charter codes of good practice, environmental management is captured under sustainable development and growth. However, these standards are more reactive-based practices relative to compliance and monitoring and not enough towards pro-active measures. The DMR does have state-owned entities (SOEs) under its jurisdiction, such as Mintek and the Council for Geosciences, where excellent research and development are taking place. If a nexus approach were to interlink energy, water and waste as a means of ensuring sustainable development in the mining sector, more interdisciplinary research needs to take place in these areas. South Africa is not only a water scarce country with a carbon-intensive energy system, but the legacy of mining is also showing, with significant signs of cumulative waste such as acid mine drainage. Solutions to these issues could enhance or complement a more efficient process as environmental externalities can no longer continue to be on the periphery.

4.5.2 Influence of the business lobby on political parties and elections

South African legislation that currently governs elections is the Electoral Act of 1998 and the Public Funding of Represented Political Parties Act of 1997. The former requires parties to commit to free electioneering, equal participation of women in political activities, allowing media access to electioneering activities, and full cooperation with the Independent Electoral Commission (IEC) (Lodge and Scheidegger, 2006). The latter determines the amount of money allocated to parties relative to the number of seats in both the national and provincial legislatures. The proportional amount accounts for 90% of the funding, and the remaining 10% is based on a threshold payment (Robinson and Brummer, 2006). The main concern concerning these two acts is the complete absence of matters on private funding.

The following is observed:

> … there are no legal limits on how much parties can spend on electioneering or any requirements for disclosure of the sources or amounts of private donations …
>
> Lodge and Scheidegger (2006)

Thus, wealthy benefactors can (intentionally or unintentionally) become indispensable sources of funding with hidden or visible motivations attached to such funding. According to Saffu (2002), in Africa countries without disclosure laws outnumber those with by a ratio of five to one. In the Southern African Development Community (SADC) region, the majority of member states (Lesotho, Mauritius, Malawi, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe) do not have disclosure provisions for the privately raised political party and campaign funds. Namibia is an exception – while it does not require full disclosure, it obliges the disclosure of foreign donations. Weissenbach (2011) further pointed out that transitional states and young democracies tended to have fewer disclosure regulations. Of the twenty-seven countries in Africa surveyed, 66% did not have financial disclosure in place. This is indicative of apathetic accountability on this issue, and it has serious implications, particularly for resource-rich countries. Collier (2007) stated that the natural resource trap is where bad governance in resource-rich countries leads to the stifling of the economy.

Furthermore, there is a tendency for minimal regulation in these countries, undermining their capacity to gain full control of the sector. Combined with this is a considerable propensity to rely on guaranteed sources of income. As such, the state is less held to account by the people.

In resource-rich countries, the implications of this abuse are increasing linkages between political sponsorship and the advocacy of self-interests, cronyism and party funding (Robinson and Brummer, 2006). Besides direct contributions to the parties, it would seem that, in order to gain the sympathy of the ruling party, many companies could buy influence by transferring some portion of their assets to favoured groups in the context of Black Economic Empowerment (BEE).

One consequence of BEE is the emergence of a symbiotic relationship between those in power and those who are now empowered in critical economic sectors. Robinson and

Brummer (2006) indicated that with the allegiances between these two groups comes certainty, which is an enviable corporate asset. In South Africa, a study revealed that in the 1999 election period the political parties spent in the order of R300 million to R500 million on their election campaigns, but only R66 million came from public money (Robinson and Brummer, 2006). No legislation at present forces political parties to declare their funding sources. The ANC secretary-general at the time, Kgalema Motlanthe (South African president from 2008 to 2009), revealed that the ANC was heavily reliant on donor funding. It was reported that the ANC receives the largest share of South African corporate funding amounting to 70% (Lodge and Scheidegger, 2006).

This report went further in identifying that the principal donors, amongst others, were the 'mining sector' (Lodge and Scheidegger, 2006, p. 35). Civil society is campaigning for transparency in the identification of funders, which could go a long way towards tackling the links between economic interests and political influence, to the extent that such influence can impact negatively on socio-economic policy, including matters to do with the environment. However, without disclosure laws, it is easier for businesses to field their interests through politicians by some form of influence peddling in exchange for guaranteed investment deals. Given the entrenched nature of mining and energy in the country's history, it should be appreciated that underlying interests in keeping the status quo are not easy challenges to overcome.

4.5.3 Integrated Resource Plan (IRP)

The Department of Energy (DOE) has updated its Integrated Resource Plan (IRP) with a decrease in demand from 454 terawatt-hours (TWh) to a range of 345 TWh–416 TWh by 2030 (DOE, 2013a). Thus, a reduction of demand meant a decrease of 6.6 gigawatts (GW) of electricity capacity required. The IRP update was apparent that modelling energy demand based on an economy with high GDP growth and a significant shift away from energy-intensive industry would be difficult to accomplish (DOE, 2013a). What was more realistic was a lower GDP forecast with minor changes in industry structure. Thus, energy investment decisions had to take into account enough supply based on practical demands, but not oversupply that would result in stranded capacity (DOE, 2013a). Ultimately, the IRP update argued that the more aggressive the constraint was for

carbon emission, which included carbon taxes, the higher the cost to the country's economic competitiveness.

This is an important narrative to take note of, as the country does not foresee decoupling carbon emission from economic growth at a cost to overall development. Again, balancing key issues of competitiveness with climate change mitigation is a constant debate within the country. In other words, it would seem the sentiment is that appropriate economic growth for the country should not limit overall developmental goals and, while GHG mitigation is essential, it may not be the most significant or decisive factor.

4.5.4 Financialisation

Financialisation is a term that is used by some to describe a combination of short-term capital inflows with a long-term outflow of capital through an offshore listing of domestic corporations (Ashman et al., 2011). The issue is essential to this chapter because the MEC is a classic example of such financialisation. As South Africa's financial sector and the system has matured (rated the strongest in Africa), so the financialisation of the MEC has become a dominant feature of the mining sector (Ashman et al., 2011). The MEC developments have favoured short-term portfolio-based capital inflows rather than foreign direct investments, which are long-term in nature (Ashman et al., 2011). The size of stock portfolios demonstrates the extent to which this has evolved the mining companies occupy within the Johannesburg Stock Exchange (JSE). The JSE market capitalisation is more than double the size of the actual economy, which is part of the global speculative commodity markets resulting in prices that are often not matched by production costs and demand (Isaacs, 2014). The MEC has historically favoured a more exclusive model – at first, the development and wealth creation of a white minority and, later, over the last twenty years, the new black elite as well as an international capital.

The political economy of the MEC itself, in turn, has a significant influence on the structure and ethos of other parts of the economy as the inter-linkages between elites are strengthened (Ashman et al., 2011). An emphasis on a global commodity market renders the economy vulnerable to short-term volatile capital flows and less long-term labour-absorbing economic growth. Essential for transformative change in the country

is less focus on short-term shareholder value, addressing the dependency on the MEC, and identifying new areas of the economy that can be de-linked from the MEC.

South Africa faces enormous problems that will take years to fix. These include a high current account deficit (6% GDP), low economic growth and continued labour friction, given infrastructure backlogs, an inadequate education system, and toxic labour relations. When there is macro-economic volatility, the rand exchange rate has to bear the brunt of this adjustment process (Isaacs, 2014). Furthermore, profits from the MEC need to be structured in a way that addresses long-term investment in the country and used appropriately to achieve development objectives, including the diversification of the economy.

4.6 Interests

4.6.1 Mineral Energy Complex (MEC)

The MEC is a set of activities that locked in and co-evolved several industries together: intensive mining, mineral processing, the energy sector and associated industries. As a result, the MEC over time was central to the South African economy. Alongside this dominance is the integration of economic sectors across mining, manufacturing and finance. Therefore, the contribution of the MEC to the economy cannot be viewed in isolation, nor can it be measured in absolute terms. In a sense, South Africa suffers from a double ‘lock-in' of a high carbon pathway dependency due to its dominant MEC, but also reliance on coal for its domestic energy derived from the MEC. The MEC also includes powerful and influential actors in the energy landscape. A system of accumulation of capital is manifested within the MEC, where consolidation of power in the hands of a few players has resulted in the creation of authoritative and influential actors over energy and economic policy, as well as access to and distribution of investment (Takala, 2008). The MEC system had effectively incorporated different parts of the economic sectors through various forms of control, ownership and its relations with the state (McDonald, 2009).

The dominance of the mining industry intrinsically gave way to a political-economic system yielding to its requirements. This is reflected in energy policies that are geared towards promoting the interests of the MEC; these include macroeconomic stability that

ensured suitable mineral exports, the creation of state-owned enterprises (such as Eskom), which are involved mainly in minerals and energy, and a labour market that was used to ensure a steady supply of low-cost labour (Takala, 2008). Thus, the level at which the MEC is entrenched and fluid within the economic structure of South Africa pose a formidable challenge in finding a potential space for alternative sources of energy (other than fossil fuel).

4.6.2 Eskom

In order to consider sustainable energy development in the country, it is necessary to take into account the dominant relevance of Eskom. This company has a 95% stake in the sector and is vertically integrated into the system (Eskom, 2014). It is responsible for the generation, transmission and distribution of electricity. The national utility is one of the largest electric utilities in the world. It was ranked thirteenth in the world by generation capacity in 2008 (Gentle, 2009). The majority of its customers are in mining, manufacturing and industry. Eskom had undergone a series of transformations over the years, mainly when it was converted into a tax-paying public company under the Companies Act of 2001, wholly owned by the state (Gaunt, 2008; Gentle, 2009). Eskom's direction changed from that of public interest to that of a corporation.

Eskom had to ensure the shareholder’s objectives were met, meaning that government and Eskom were now closely aligned (Gaunt, 2008). Conversely, the Municipal Electricity Undertakings (MEUs) are owned by the municipal councils, which, in their governance, are in turn accountable mostly to customers and voters in the local community, giving rise to a different set of objectives (Gaunt, 2008). Therefore, competing interests exist, particularly on issues surrounding increasing electricity costs. A mindset can then develop in which Eskom's central imperative is seen as ensuring profit while MEUs tend to address electricity price affordability.

Given that, Eskom is entrenched, and a significant monopoly in the energy system in the country, it will take some time to attain a different balance in the industry. In this regard, the Independent Systems Market Operator (ISMO) Bill has been proposed for more than a decade. It is a bill that would facilitate the introduction of Independent Power Purchasers (IPPs) to the system, providing competition in electricity generation, and

result in the unbundling of the current monopoly. However, at present, the bill has almost been rejected in its totality because, among others, it would undermine the state's leverage in the energy industry and would cause too much disruption in the context of the current generation shortfalls. Therefore, the dominance of Eskom remains, although the recent introduction of IPPs may change the balance somewhat. The issue of decoupling state-owned energy supply to the mines also arises in this context. Furthermore, the issue of privatisation has been debated for over a decade, but the preference within the state is to retain the status quo rather than restructuring the entire electricity system. With the current challenge of load-shedding, the weak financial position of Eskom, lack of progress in new energy builds, and inconsistent leadership at Eskom, critical questions are starting to be asked about the proportion of IPPs in the system and funding models for Eskom, which may include a sale of part of the company's equity.

The ISMO bill is an excellent example of how competing interests continue to hamper energy reforms. As previously discussed, Eskom has had mutually reinforcing relationships between its extensive and intensive users, indicative of its historical ties to mining. Eskom depends on a few privately owned coal companies. Furthermore, the majority of its customers are represented by 31 large industrial consumers known as the EIUG, which accounts for 44% of the electricity consumption[11]. The five biggest coal companies are Anglo-American, Xstrata, BHP Billiton, Sasol mining and Exxaro (Eberhard, 2011). Thus, the nucleus of economic growth and electricity infrastructure had started from Mpumalanga Province due to abundant coal and mining activities and then stretched to the main cities as the economy grew.

As a result, large industrial users have incurred minimal distribution costs, and this has created a two-tier system. Eskom has a first-tier customer base of industrial users and a second-tier service to the municipalities (Rustomjee, 2014). Thus, any significant structural changes to Eskom would cause instability, price uncertainty and disruption of the mutually entrenched relationship with its existing users (Rustomjee, 2014), not to

[11] Energy Intensive Users Group (EIUG), www.eiug.org.za

mention the possible economic impact it may have, as the central imperative at present is to ensure short-term electricity supply with future grid stability.

The current electricity crisis in the country is focusing energies on leading short-term solutions, and sustainable development may not receive adequate attention and could be relegated to the long-term. Thus, managing between these time frames is one of the critical issues that will require attention to defining energy projects. Without such a balance, the outcome may be to lock the country into business as usual with more fossil fuel derived resources such as coal. However, greener options towards more renewables are available and need to be pursued. Thus, despite well-informed reports such as the IRP update, or LTMS, with parallel uncertainties in future oil prices or global commodities demand, it should be appreciated that bold decisions are neither easy nor sequential. It is often repeated that vested interests among a few players, mainly associated with the MEC, are crucial to energy investment decisions. As long as these vested interests continue to dominate, and as long as they do not change their own paradigms, deviations from the norm will confront persistent barriers. In the recent period, a number of these large corporations have offered to contribute to electricity generation using gas (e.g. SASOL) or even the more innovative fuel cell technology, which uses a significant level of platinum group metals (PGM). The latter, if it ever takes off in earnest, may open up possibilities for a new MEC relationship as it combines beneficiation with green technology (in that, the by-product of the fuel cell generation process is water).

4.6.3 Energy security and coal exports

Another substantial challenge for Eskom relates to the prospect of increased demand for low-grade coal. Traditionally, Eskom has had a reliable source of coal because it was of low quality and not suitable for export. South Africa depends on its export revenues and coal accounts for the third largest export after gold and platinum (Nkomo, 2009). Additionally, export revenues do not only fund the country's import expenses, but they are also used for the development of new industrial sectors (NPC, 2012). This is a recurrence of the country’s dependence on the MEC. The demand for RB3 low-grade coal has increased, particularly in countries such as India and China (Eberhard, 2011).

Subsequently, Eskom is lobbying the government to recognise coal as a 'strategic national resource' ensuring that it takes priority relative to energy security (Creamer, 2011). Diversifying South Africa's use of resources away from coal and into renewable energy will take time, and so it will remain a critical asset. This reiterates the number of competing dynamics to be considered, both in short- and the long-term.

4.6.4 Cosatu, climate change and the green economy

The Congress of South African Trade Unions (Cosatu), with approximately 1.8 million members (Cosatu, 2015; Politicsweb, 2012), is the largest trade union federation. Until recently, the single biggest affiliate was the National Union of Mineworkers (NUM) with 300,000 members. The largest union affiliate is now the National Union of Metalworkers South Africa (Numsa), which, at the time of publication, was fighting its expulsion from the federation. Cosatu has a structured alliance with the ruling party, namely the African National Congress (ANC) and the South African Communist Party (SACP), which together form the Tripartite Alliance (Webster, 1998; Piper and Matisonn, 2009; McKinley, 2001). There are significant policy dialogues that occur within this alliance, and it is an essential source of information for the current ruling party, the ANC (Buhlungu, 2008; Mohanty et al., 2011; Webster, 1998).

According to Cherry (2006), Cosatu has a multifaceted interaction with, and influence on, the government using the following:

- Advocacy (for example social security for the poor, job creation and privatisation)
- Negotiations in the National Economic Development and Labour Council (Nedlac)
- Working through political processes of the Tripartite Alliance
- Mass mobilisation (such as action through collective strikes)

These structures of communication cannot be understated because they can have significant implications when it comes to implementing policies that may or may not be welcomed by Cosatu. There is a tendency for the majority of the people to support mass

action as a complementary strategy for putting pressure upon elected politicians if the government fails to deliver promised benefits, most notably demonstrated in ‘service delivery protests’ (Mohanty et al., 2011; Buhlungu et al., 2008). Mass and repeated strike action over prolonged periods can cripple the economy. Thus, Cosatu is central to the ongoing dynamics within government policies and strategies, especially at the grassroots level, as well as government, industrial sectors, and civil society.

4.6.5 The mixture of business and politics

The most significant development in this sector has been BEE deals which have resulted in black-owned coal companies controlling more than 30% of South African coal production. The most massive BEE deal of 2003 illustrates the lack of breadth in the empowerment process. The deal was between ARMGold and Avmin for R10.6 billion. The emergence of large black operators in an economy that had been solely dominated by whites is not a backward step as such. However, the transfer of wealth from one elite group to another – without a structural change in the path dependency – mostly perpetuates old patterns of social inequality. The system of wealth accumulation and the continued privilege of elites need to be confronted in the broader process of transformation. This skewed distribution of wealth has also resulted in the creation of powerful actors that are influential in determining the energy policies of the country. Moreover, this lopsided distribution of wealth may, in fact, keep the division of the ‘two world economy'. The two world economy refers to one end of the spectrum where South Africa has high living standards and access to infrastructure (which includes the basics such as electricity, water and sanitation) that are comparable to those in more developed countries (McDonald, 2009; Winkler and Marquard, 2009). However, at the other end is the poor population who lack access to basic living standards (housing, health, education and energy). This disproportionate situation is primarily due to the legacy of apartheid, which has embedded many socio-economic challenges and issues.

4.7 Way forward

As a way of understanding this multitude of issues, a framework by Voss and Kemp, 2005, is discussed. They proposed a reflexive governance approach whereby formulating policies should be an exercise of flexibility and adaptability. Since

sustainable energy development is a complex issue, knowledge from various sources is required. Knowledge production cannot only rely on scientific sources; it also needs to take into account the needs of societal actors (Voss and Kemp, 2005). There is a need to create 'integrated knowledge production' that enables information, not only from within the boundaries of science and policy but transcends these towards society in general (Voss and Kemp, 2005, p. 10). In terms of uncertainty, future energy development cannot be predicted with precision, nor can it be predicted for its systemic effects. Therefore, a level of 'adaptivity' and flexibility is needed relative to the institutions and technological systems that govern implementation (Voss and Kemp, 2005, p. 11). An important factor here is to *capacitate* the system to respond to changes adequately and proactively. Moreover, a continuous system of *monitoring and evaluation* needs to be in place once policy implementation starts.

Energy investments have a long lifespan and changing trajectories is not easy as prior technologies are path dependent or lock in for a specified timeframe. Specific patterns are realised and stabilise within social values, institutions and societal systems. An example here is coal-derived electricity. Most people need a consistent and reliable electricity supply, and whether the source is carbon-intensive is usually a secondary matter. Therefore, an energy technology choice needs to take into consideration the long-term systemic effects. South Africa continues to be locked into a carbon-intensive energy system, and some may argue that business as usual needs to continue because coal is abundant and cheap. However, South Africa needs to ask itself whether current efforts to gradually extricate itself from this carbon-intensive system are adequate, and how stakeholders within the energy and sustainable development community can work together towards optimal solutions.

Strategy implementation requires *meta-coordination,* not only within and among government departments, but also with various stakeholders. Significant factors to consider for implementation are: 1) the project must have a defined champion with clear mandates; 2) there should be sufficient institutional capacity where projects are aligned to mainstream and existing initiatives at scale; 3) create a conducive and supportive context for policy, regulation, and planning, and ensure ownership of the integrated process; 4) ensure that projects are aligned to national priorities which

should assist in mainstreaming and alignment with broader mandates or enhance existing mandates and, lastly; 5) there must be sufficient technical capacity to enable the project to be sustainable.

Among the measures required to reduce the country's dependency on the MEC would be to take up in earnest, the opportunities opened up by the knowledge-based economy. This will ensure that the country is more resilient to volatile commodity markets and is less reliant on primary resources. The experience from the mining industry can stand the country in good stead, particularly concerning the knowledge base that includes production or process engineering, as well as research and development. An important consideration is to focus not only on the continuous output of mining resources and seeing the minerals as an end in themselves. Preferably, the knowledge underlying the processes of obtaining these minerals should be utilised to diversify or enhance other sectors of the economy. Examples could include technological innovation in mechanisation process, machineries, parts, tools and equipment – all of which could spill over into essential sectors such as transportation, information technology, construction and manufacturing. Sound economic policy and planning that have evident growth and development objectives should dictate how mining investments flow and how revenues or income generated from the mining sector are managed for the benefit of society as a whole.

4.8 Conclusion

There is no doubt that mining in the country will continue to be a dominant sector in the years to come. However, the sector is undergoing significant challenges that cut across significant issues which are at the heart of the country’s developmental goals that include labour, economic growth and unemployment. The role of the MEC is indicative of the entrenched regime that the mining sector plays within the economy. The MEC has broadened itself into a system of wealth accumulation and has integrated large sectors that include mining, transport, manufacturing and finance. As was discussed, the EIUG is also one of the biggest companies in the mining sector, as well as the JSE. Due to a system of wealth accumulation, there are a handful of players in this sector and thereby also a few powerful actors that are influential in determining key policies and

strategies. Thus, the argument in this chapter is that vested interests within the MEC are vital in understanding the implementation of energy policies in the country.

The issue of ideological mismatch between a developmental state and a more neo-liberal economy is a fundamental obstacle. The influence and the role of trade unions cannot be overstated: significant policy dialogues take place within the Tripartite Alliance. Unbundling Eskom has been stalled several times and is part of a more considerable privatisation debate that encompasses the nationalisation of mines and selling off some of Eskom's assets. The ideological mismatch has to be tackled because it is a root cause for policy incoherencies and implementation inertia.

The subject of financialisation is indicative of a need for significant reform in the structure of the economy. Investments made by the mining sector that favour profits flowing out of the country instead of long-term financial investments are compounding developmental challenges. These include uneven wealth distribution mostly skewed towards elitism and wealth concentration; thus, inequality persists. The JSE total market capitalisation is twice the size of the actual economy. The emphasis on a commodity market renders the economy vulnerable to short-term volatile capital flows, and not necessarily long-term labour-absorbing economic growth. The current energy crisis provides an opportune moment to revisit the country’s mining economic policy.

CHAPTER 5

Paper 2: Eskom and the rise of renewables: regime-resistance, crisis, and the strategy of incumbency in South Africa's electricity system

Marie Blanche Ting[1], Robert Byrne [2]

[1, 2]Science Policy Research Unit (SPRU), University of Sussex

This Chapter has been published as an article by Energy Research Social Science Research (ERSS) and is co-authored with my supervisor Dr Robert Byrne. I had conceived the case study, reviewed the relevant empirical and theoretical literature, developed the theoretical framework, collected the data, analysed, and interpreted the results. My co-author helped refined the argument, improved the structural flow of the paper, through numerous iterations. During the submission to ERSS, I assumed the role of the corresponding author. The feedback received from the journal required substantial edits, clarifications, and rebuttals. I had written the majority of the responses to the reviewers, and my co-author helped streamlined the responses.

5.1 Abstract

The sustainability transitions literature considers regimes as sources of inertia, in which change is difficult to achieve due to resistance and lock-in. However, regime-resistance is an understudied issue, and so it is unclear which parts of the regime create resistance and how. In this paper, we contribute such an analysis by developing the concept of a multi-dimensional selection environment to explore regime-resistance and the maintenance of regime-stability in the face of challenges from a niche. We present a case study tracing the efforts of South Africa's state-owned electricity utility Eskom, conceptualised as a dominant regime-incumbent, to resist the addition of renewable energy-based electricity generation, conceptualised as part of a niche. We examine battles over rule-changes to the regime selection environment, wherein Eskom tried to maintain the status quo and niche actors tried to transform it. We find that Eskom had an evolving strategy of regime-resistance in response to several gains achieved by the renewables niche over time. Our analysis suggests ways to theorise regime-resistance by developing a more specific and dimensioned view of the selection environment and operationalising the strategies that regime and niche actors might implement in their respective attempts to maintain or change that selection environment. By understanding how these strategies work, we argue that those seeking to transform an unsustainable regime could develop more effective strategies for undermining regime-resistance and promoting niches.

Keywords: regime-resistance, incumbency, regime and niche interactions, energy transition, institutional theory, drift and layering

5.2 Introduction

This paper examines how a regime-incumbent has resisted efforts to achieve socio-technical change that would benefit a more sustainable niche. The paper's focus is of interest to sustainability transitions research as, although regimes are conceptualised in terms of lock-in and resistance to change through inertia (Geels, 2014b), there are claims that sustainability transitions theory is unclear which parts of the regime create resistance and how (Wieczorek, 2018). A clearer understanding of regime-resistance could open up ways to overcome it (Unruh, 2000; Klitkou et al., 2015) and could

contribute to accelerating sustainability transitions by, for example, identifying ways to destabilise an existing regime (Turnheim and Geels, 2012; Karltorp and Sandén, 2012; Kungl and Geels, 2018), while promoting innovative niches (Kivimaa and Kern, 2016; Sovacool, 2016). To address this gap, we develop the concept of a multi-dimensional regime selection environment and examine the struggles between a regime-incumbent and emerging niche over changes to the rules that profoundly shape that selection environment (Nelson and Winter, 1982; Geels and Schot, 2010; Smith and Raven, 2012).

Moreover, our paper responds to calls to contribute to the nascent literature analysing socio-technical energy transitions in developing-country contexts (Hansen et al., 2018). The paper provides a case study of a country in the Global South in which a regime has tried to resist socio-technical change. As such, in addition to an empirical contribution, the paper provides insights for enriching how we can theorise regime-resistance, with associated insights for how policy can be used more strategically to accelerate sustainability transitions in Global South contexts.

To examine regime-resistance, we present a case study of South Africa's electricity socio-technical system in which we trace how the state-owned utility Eskom has, over the period 1998 to 2018, attempted to resist the growth of renewable energy in the electricity supply mix. Eskom is a central actor in South Africa's powerful Minerals-Energy Complex (MEC) (Fine and Rustomjee, 1996) that, amongst other interests, has long tied coal mining together with electricity generation and consumption (Ting, 2015), and continues to be a significant force in the country's economy (StatsSA, 2017; COM, 2018; Baxter, 2016). However, despite the power of these coal-based interests and Eskom's efforts to resist change, renewable energy-based electricity generation has seen impressive growth in South Africa in recent years, reaching 3.6 GW of generation capacity as of 2018 (DOE, 2018a). The case provides a useful example of how socio-technical change can be achieved despite the presence of a powerful incumbent. To drive our analysis, we ask the research question: How has Eskom resisted the introduction of renewable energy-based electricity generation in South Africa?

We frame our theoretical approach in terms of the multi-level perspective on sustainability transitions (Rip and Kemp, 1998; Geels, 2002a), within which we conceive of Eskom as the dominant incumbent within a regime constituted by the MEC, and

renewable energy electricity generation technologies and associated actors as constituting the niche. To sharpen our focus, we concentrate on contestation over rule-changes to the regime's selection environment, a crucial space where strategic actors compete to influence and shape outcomes (Kuokkanen et al., 2018). Drawing on the notion of a socio-political regime (Swilling et al., 2016), and drift and layering concepts from institutional change theory (Streeck and Thelen, 2005; Mahoney and Thelen, 2010; Fuenfschilling and Truffer, 2014), we develop a multi-dimensional selection-environment concept and postulate strategies for regime-resistance and niche-challenge. Applying these ideas enables us to analyse the actions employed by both regime and niche actors in their battles over rule-changes in the selection-environment. We find that Eskom has used an evolving resistance strategy in response to various gains achieved by the renewables niche, and this finding further reveals the specifics of regime-resistance and niche-challenges in their interdependent dynamics as played out in South Africa's case.

The paper proceeds as follows. Section 5.3-5.5 provides the paper's conceptual basis, discussing socio-technical regimes, institutional change and the two strategies regime-resistance and niche-challenge. Section 5.6 explains the methodology and includes a discussion of how the resistance and challenge strategies are operationalised in terms of the regime selection environment. Section 5.7 discusses the socio-technical context of the case study, where the case study itself is presented in Section 5.8. In Section 5.9, we reflect on the case study and discuss what the implications for theorising regime-resistance are, along with thoughts on what this means for accelerating sustainability transitions. Section 5.10 concludes briefly, summarising the main points of the paper.

5.3 Conceptual discussion

5.3.1 Socio-technical transitions

In the socio-technical transitions literature, the dominant way of realising any societal function – such as electricity production and consumption – is called a socio-technical regime, sitting at the meso level in a multi-level perspective (MLP) (Geels, 2004a; Grin et al., 2010; Bosman et al., 2014). At the micro-level are socio-technical niches, where novel (more sustainable) technologies and practices are the focus of experimentation

(Geels, 2002b). The context of both regimes and niches is called the landscape (the macro-level), where heterogeneous factors that are difficult to affect directly play out (e.g. environmental change, natural events, demographic trends, etc.) (Geels, 2004a). Although this literature mainly focusses on how landscape pressures (e.g. climate change) create conditions that niches (e.g. based on renewable energy technologies) can exploit as they strengthen and stabilise, eventually replacing old regimes, there is increasing attention to how old regimes weaken or destabilise – the so-called 'flipside' of transitions (Turnheim and Geels, 2012). Associated with regime-destabilisation is resistance to change, an understudied issue in transitions literature where there is uncertainty over which parts of the regime enable resistance (Wieczorek, 2018). Examining regime-resistance can inform specific ways to weaken or destabilise regimes and so accelerate sustainability transitions. To examine regime-resistance, we build on the concept of the selection environment – a foundational regime concept – that tends to favour regime reproduction (Smith and Raven, 2012; Kivimaa and Kern, 2016; Raven, 2005; Geels, 2011) and so changes to it could help achieve such acceleration.

By focussing the analysis of regime-resistance on changes to the selection environment, we can see how the selection environment is actively shaped by strategic actors, both within and beyond the regime (Kuokkanen et al., 2018, p. 1513). We anticipate that attempts to change the selection environment will likely stimulate regime-resistance, so our analyses must attend to the dynamics of power, politics and agency in struggles over regime-change (Avelino, 2011; Meadowcroft, 2011; Geels, 2014b). Using this logic, and to help us understand more systematically how regime-resistance and niche-challenges co-evolve, our aim in this section is to develop a multi-dimensional concept of the selection environment. To do this, we need to take several steps (see Figure 5.1 for a summary of these steps and associated concepts). For a summary of these steps and associated concepts). After reflecting in Section 5.3.2 on the importance of rules (another foundational regime concept) and how these relate to institutional theory, in our first step, we draw on the institutional change modes of drift and layering (explained in 5.4) to characterise how regimes might defend – and niches might challenge – the status quo. Second, in 5.5, we develop our multi-dimensional selection environment concept. And, third, we translate the drift and layering change modes into resistance

and challenge strategies (respectively), relating these to the multi-dimensional selection environment (see Sections 5.5.1and 5.5.2).

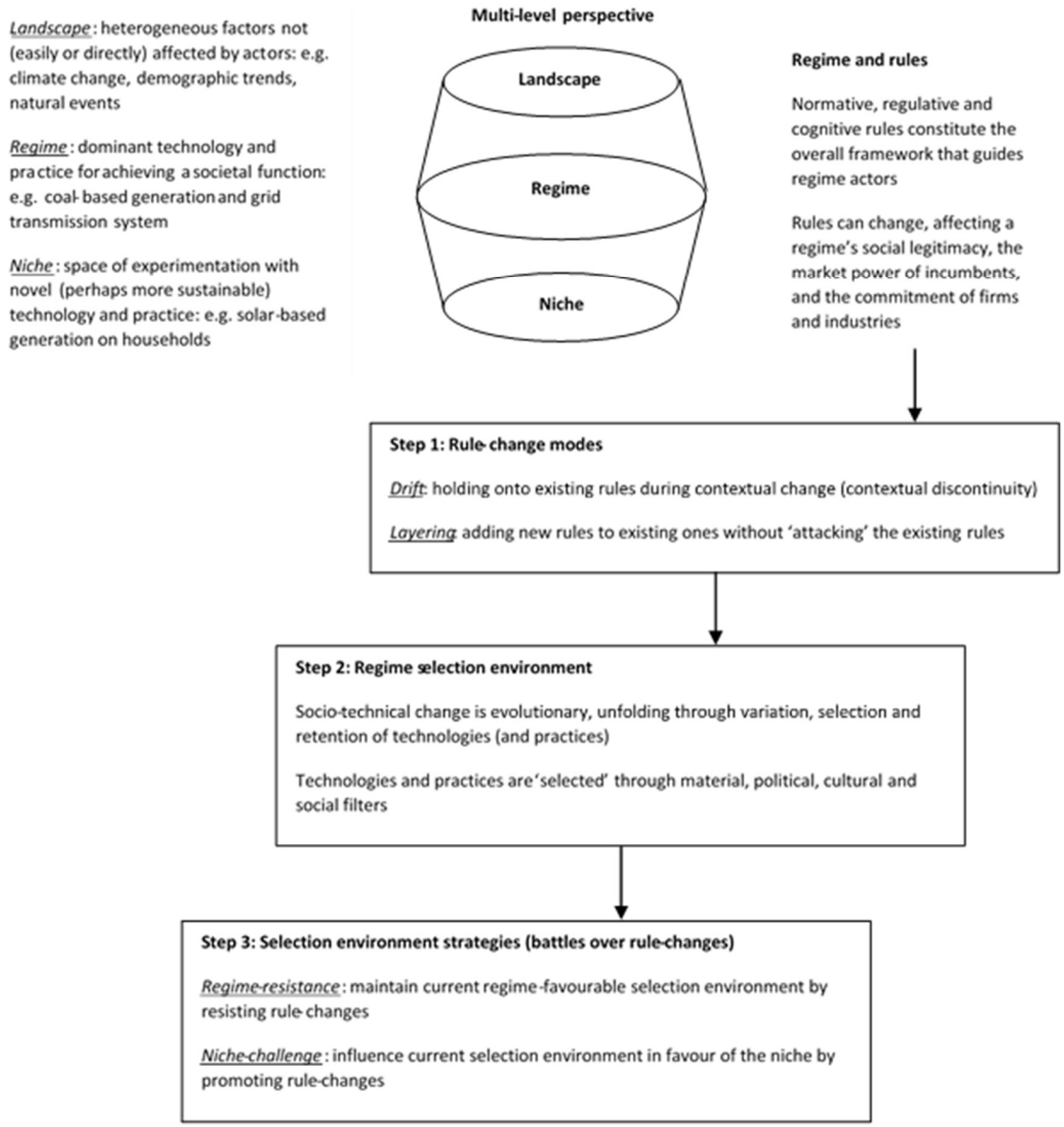


Figure 5.1 Summary of the conceptual discussion steps and the main ideas

5.3.2 Socio-technical regime and rules

Rules are at the heart of the socio-technical regime concept, forming the overall guiding normative, regulative and cognitive framework that provides the functional relationship between material resources, actors and the socio-technical regime's organisational networks (Genus and Coles, 2008; Kivimaa and Kern, 2016). Rules (such as normative values, technical regulations or planning heuristics) can change, affecting social legitimacy (impacting political and public support), the flow of economic resources (increasing or reducing market power), and the commitment of actors (thus shaping the organisational networks of regime-incumbents or niche-challengers). Taken together, changes unfavourable to a regime could lead to its destabilisation (Turnheim and Geels, 2012) and so create opportunities for niche-expansion. Public policies, and associated regulations and standards, etc., are formal rules and have a profound effect on the selection environment. Attempts to change rules, therefore, will likely stimulate battles between regime and niche actors as they seek to either maintain the selection environment (regime actors) or open it up to transformation (niche actors). Thus, we argue that examining battles over rule-changes that could change the selection environment will help us reveal the dynamics of both regime-resistance and niche-challenges.

With this brief rationale for focussing on rule-changes, we note that the socio-technical regime concept draws heavily from neo-institutional theory, whereby rules are embedded in structures that are both context and outcome of actions (Geels, 2004a; Geels, 2011). Moreover, Fuenfschilling and Truffer (2014) use insights from institutional theory to develop a systematic characterisation of regime structuration that enables analysis of, amongst other things, the degree of regime stability. While these contributions are useful for understanding regime stabilisation and reproduction, we are interested in this paper in how regimes respond to niche challenges and so draw on the theory of incremental and endogenous institutional change (e.g. Streeck and Thelen, 2005; Mahoney and Thelen, 2010) to examine regime-niche dynamics during attempts to change a selection environment's rules.

5.4 Rule-changes and institutional theory

Turning to the institutional theory literature, we first note that, according to Streeck and Thelen (2005), institutional theory usually emphasises institutional reproduction and the maintenance of stability, where the change results from exogenous shocks that stimulate radical institutional reconfigurations and a new stability in the process of punctuated equilibrium. However, they argue this emphasis overlooks the incremental institutional changes occurring endogenously. As Mahoney and Thelen (2010) reason, there could be internal institutional reconfigurations during times of apparent stasis or stability. Thus, we draw on concepts of endogenous institutional change for analysing internal regime processes rather than exogenously derived punctuated equilibrium.

We develop our conceptual framework starting with the two institutional change modes drift and layering, drawing on the work of Streeck and Thelen (2005) and their characterisation of how institutional change occurs. Drift is a mode in which formal rules are held constant in the face of contextual change, and layering is a mode in which new rules are added alongside old ones. We now discuss these two modes of institutional change more fully and justify why they are appropriate for helping us understand the dynamics of regime-resistance and niche-challenges in the recent evolution of South Africa's electricity system.

5.4.1 Drift: holding on to rules

Drift is defined as a mode of change in which a powerful incumbent tries to maintain the stability of existing institutions that serve its interests despite essential changes to its context, described as contextual discontinuity (Hacker et al., 2015). Contextual discontinuity could mean new institutions are needed, but the incumbent resists them when it believes they will be detrimental to its interests. Hacker et al. (2015) argue that drift enables institutional change to be resisted away from public scrutiny. Contestation in the public domain can spark initiatives that may lead to the mobilisation of competing interests. In contrast, a hidden resistance strategy can allow the more politically-versed and better-resourced incumbent actors time to mobilise their shared interests, shape

and influence outcomes, and disable the voices of those with divergent interests (Lockwood et al., 2017; Andrews-Speed, 2016).

In South Africa, electricity-production has been dependent on coal for more than ninety years, and coal-fired electricity constitutes 90% of the generation fleet (Eskom, 2016b). Consequently, Eskom is responsible for about 43% of South Africa's carbon emissions (Eskom, 2016a) and so is under pressure to adapt to a lower-carbon trajectory. Climate change, therefore, constitutes a contextual discontinuity and the need to act on it requires new institutions that promote, for example, renewable energies.

5.4.2 Layering: adding new rules alongside the old

Layering is defined as the addition of new rules alongside existing ones where the new rules do not 'attack' existing institutions but rather solve problems caused by them (Hacker et al., 2015; Streeck and Thelen, 2005). We might see problems arise, for example, when an incumbent is employing a resistance strategy whereby the incumbent's failure to respond to a contextual discontinuity causes the regime to fall into crisis. This can open a window of opportunity for a niche to exploit. Layering, in this sense, can be described as an incremental adjustment, or what Geels et al. (2016) call 'fit-and-conform', where a niche-innovation develops within the existing selection environment. Layering allows new and old institutions to co-exist over time, but the new layered institutions could outlive the old leading eventually to more substantial change.

5.5 Strategies in a multi-dimensional selection environment

The selection environment helps explain socio-technical change through the quasi-evolutionary approach of variation, selection and retention (Nelson and Winter, 1982). As various technologies are introduced into society (variation), their adoption and diffusion (selection) are filtered through a selection environment that contains material, political, cultural and sociological dimensions. In other words, socio-technical change is 'selected' not only by markets but also by social fitness such as values, beliefs, expectations and visions amongst actors (Geels and Schot, 2010). Moreover, once technologies are adopted in society, there is a process of 'retention' and 'reproduction' – or 'lock-in' – that occurs through establishing regulations (e.g. government subsidies), legally binding contracts, market parameters such as scale and sunk investments, as well

as sociological structures that include cognitive routines, and power and politics, making changes away from the retained technologies difficult (Geels, 2014b; Smith and Raven, 2012; Meadowcroft, 2011; Geels and Schot, 2010).

We can now make our second step, elaborating the dimensions of our selection environment concept before proposing, in a final step, how regime-resistance and niche-challenges could play out on those dimensions. For the selection environment dimensions, we consider calls that attention is needed in transitions research to power, politics and agency (Kuzemko et al., 2016; Swilling et al., 2016; Johnstone et al., 2017; Geels, 2014b). Attempted regime changes are likely to encounter resistance and are therefore deeply political because of vested interests and power relations, which tend to favour the status quo (Kuzemko et al., 2016; Geels, 2014b). Thus, we draw on concepts related to socio-political regimes (Swilling et al., 2016) and hegemonic social structures (Levy and Egan, 2003). Specifically, Levy and Egan (2003) argue that dominant socio-economic structures, which constitute alliances amongst particular groups, can assert supremacy through the persuasive and bureaucratic authority of the state, the dominance and favoured market position within an economical configuration, ideologies that perpetuate mutual interests, and the consensual legitimacy of civil society. In Swilling et al. (2016), the ways in which power relations are created, disseminated and maintained, influence prevailing beliefs, particularly in framing and shaping the terms of debate and adoption of policies. Using these ideas, we derive the dimensions of organisational networks and capacity (organisation capital reflects how power relations are exercised), discursive structures (power of ideologies), and the market (dominance of specific economic configurations). Further dimensions relate to material elements of the socio-technical regime: e.g., formal rules such as policies, legislation and standards enable the continued dominance of incumbents and associated technological preferences, and large technical systems tend to create sunk investments (Geels and Schot, 2010). From these, we derive the two further dimensions of public policies and technology and infrastructure.

Bringing these ideas together, we can now describe the dimensions of our reconceived selection environment: (1) markets, (2) organisational networks and capacity, (3)

discursive structures, (4) public policies, and (5) technology and infrastructure. We elaborate on these below (and see Figure 5.2).

Markets: A regime-incumbent tends to have established market relationships with industries and government and enjoy widespread social legitimacy. Embedded institutions – those institutions that are deep-seated and in widespread operation – tend to reflect these relationships, providing the incumbent with a dominant market position (Kuzemko et al., 2016). The market selection environment is stabilised through price instruments, and customer preferences and practices, each of which has co-evolved with the regime, thereby favouring its reproduction (Smith and Raven, 2012).

Organisational networks and capacity: A regime will likely include at least one industrial association, as well as broader networks involving strong relationships between users and firms. There is also the prevailing knowledge base, with dedicated research programmes, groups, and actors' similar search routines. The current knowledge base, practices, search routines, and so on, favour reproduction of the regime and the incumbent's organisational networks as well as the maintenance of existing power relations. The ways in which organisational networks are constituted, maintained and operated reflect existing power relations (Swilling et al., 2016; Levy and Egan, 2003).

Discursive structures: Incumbents hold a privileged position over prevailing ideologies and beliefs amongst powerful elites, maintaining those ideas as accepted norms that structure relevant discourses. For example, regime actors might have preconceived ideas about the compatibility of new technologies with an existing technical system (Unruh, 2000) and use their position to persuade others of their preconceived ideas. This discursive dimension of the selection environment favours the reproduction of the regime by constraining debate over technology and policy choices to those that maintain regime and incumbent interests.

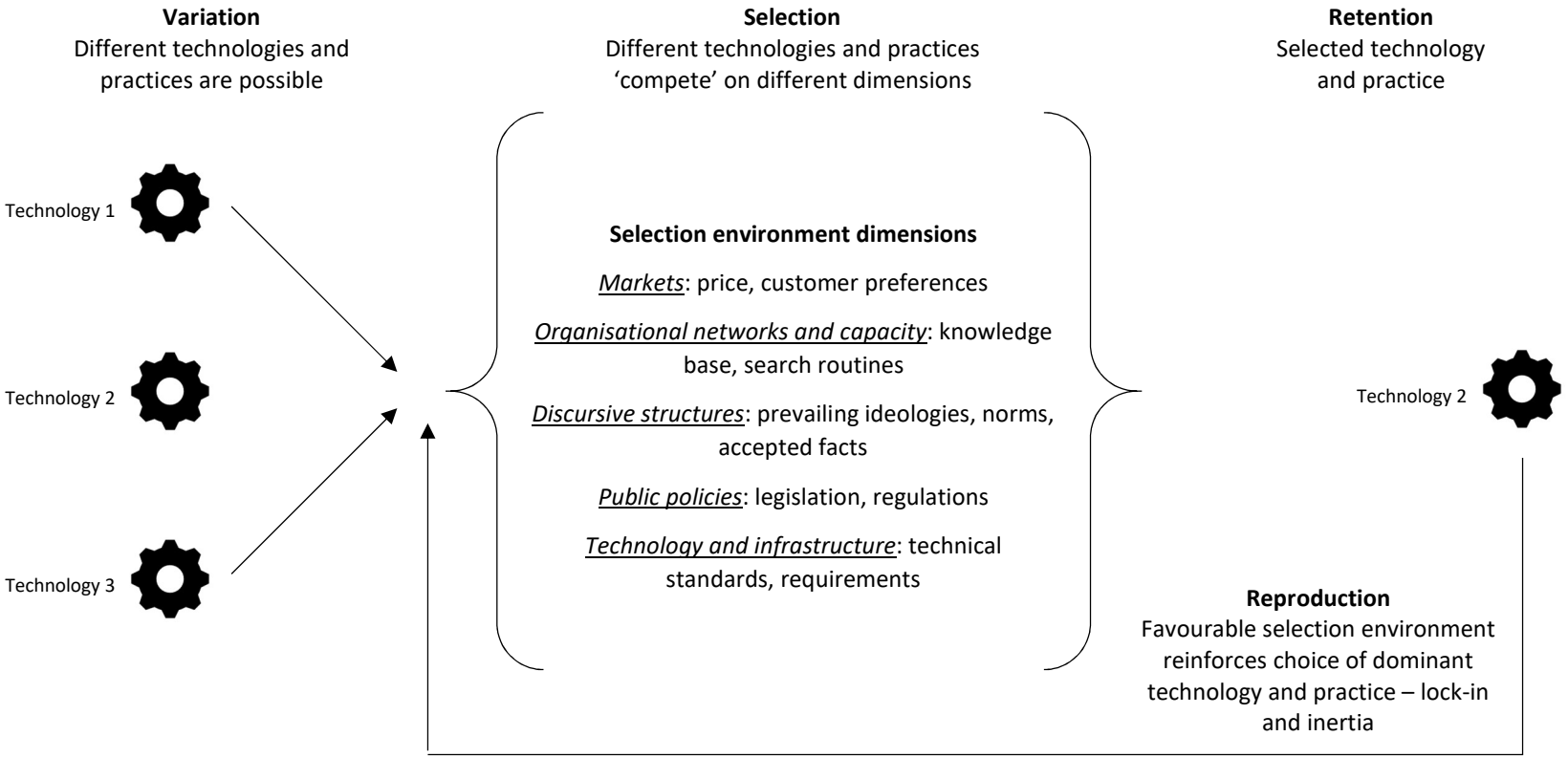


Figure 5.2: Quasi-evolutionary approach to socio-technical change and a multi-dimensional selection environment

Source: Authors' construction

Public policies: These translate normative societal views into formal rules such as legislation and regulation that profoundly condition the institutional selection environment (Kivimaa and Kern, 2016). Existing institutions, or formal rules, have co-evolved with the regime and so favour its reproduction.

Technology and infrastructure: Technical standards and infrastructure requirements constitute a technical dimension of the selection environment, and existing standards and requirements are usually favourable to a regime-incumbent (Smith and Raven, 2012).

5.5.1 Regime resistance strategy

With this brief description of selection environment dimensions, we can consider what drift might look like as a strategy for maintaining a regime-favourable selection environment. Drawing on Hacker et al. (2015), we note that delayed action or non-responsiveness enables regime actors to resist rule-changes by conducting a debate on technology and policy choices away from public scrutiny. In our selection environment terms, by confining the debate to hidden spaces amongst its organisational networks, a regime-incumbent would be better able to control the terms of the debate, thus maintaining the prevailing regime-favourable discursive structure. Moreover, those outside the regime and its organisational networks – uninformed about the hidden debate – would be less able to develop an alternative discursive structure, and so would be less likely to influence the debate. In turn, rule-changes – to policies, market institutions, technology standards, etc. – will rest on addressing a narrow regime-favourable agenda and so will tend to maintain the existing selection environment.

5.5.2 Niche challenges strategy

If a regime-resistance strategy is about the maintenance of the status quo, niche-challenges are about achieving change to the selection environment. Where regime-resistance would be employed by a regime-incumbent, layering would be sought by niche actors. They would look for opportunities to get a foothold in the regime on any dimension of the selection environment. For example, contextual discontinuity might

demand a policy-response, and so niche actors could try to influence public debate in favour of their preferred choices in a bid to secure niche-promoting rule-changes. However, if the debate is being conducted in hidden spaces, niche actors will face challenges to achieve influence. Faced with such challenges, niche actors would have to frame their preferred solutions in terms that do not appear to 'attack' the core rules of the regime – the fit-and-conform strategy described by Geels et al. (2016) – so as not to explicitly threaten disruption of the selection environment. This challenge will be exacerbated if niche actors are unable to provide facts and other ideas that may dislodge or destabilise those already structuring the prevailing discourse. To achieve influence, niche actors must be able to seize an opportunity when it arises but do so when in possession of persuasive facts and other discursive elements or, as Geels and Schot (2007) argue, when a niche is sufficiently well-developed to be able to exploit the opportunity effectively.

5.6 Methodology

South Africa's electricity system is an example of a socio-technical system that is path-dependent, with strong vested interests in maintaining the status quo. Given the nature of the vertical integration of Eskom and its position within South Africa's MEC, renewable energy developers must contend not only with the challenges of relatively new technologies but also with the powerful governing interests that seek to maintain the regime.

In our case study, we conceptualise the electricity socio-technical system as embedded within a regime constituted by the MEC (see Section 5.7 for a fuller explanation of the MEC), within which Eskom is the dominant incumbent, and we conceptualise renewable energy and associated actors as a niche. From 1998 to 2018, South Africa's electricity system experienced a series of changes and a crisis of supply, as well as a growing renewable energy programme. During this period, we argue, Eskom has responded to change by employing a resistance strategy that contributed to the electricity-supply crisis. This, in turn, created a window of opportunity for renewables through which the layering of new institutions for their promotion was possible. As such, the South African case offers a useful example with which to examine the interdependent dynamics of regime-resistance and niche-challenges. To reveal these interdependent dynamics, we

ask the research question: How has Eskom resisted the introduction of renewable energy-based electricity generation in South Africa?

We confine our set of core rules for the incumbent to (1) Eskom provides and maintains cheap electricity and (2) Eskom is a supplier of last resort. Eskom's mandate as a supplier of last resort means that the government has tasked the utility by all means necessary to maintain reliable electricity supply. We derive these rules from the fact that Eskom has been South Africa's central electricity supplier for more than ninety years, and that electricity-supply has developmental objectives tied to affordability, accessibility, and reliability. However, we caution that these rules form a subset of those that make up the socio-technical system and do not include, for example, coal and its associated industries.

We consider displays by the incumbent such as resistance, delay, inertia, inaction and indecision to be instances of drift. To elaborate, drift is evident when the incumbent delays market reforms, which can be an effort to maintain market dominance and avoids compliance with new rules, disrupting the functioning of the socio-technical system and placing organisational networks in limbo. Information asymmetry can be used by the incumbent to skew discussions in their favour and confine deliberations within their organisational networks such that contestation is shifted out of public sight, limiting the capacity of oppositional groups to mobilise social movements against the incumbent. Moreover, the incumbent can stall infrastructure reforms, preventing new entrants from competing effectively. Table 5.1 overlaps these instances with the selection-environment dimensions discussed in Section 5.3.

Table 5.1 also summarises layering operationalised under each of the selection-environment dimensions. We consider layering to mean, for example, widening the participation of formerly excluded actors, such as the inclusion of the private sector into the otherwise monopolised electricity market, resulting in new user-producer relations. For organisational capacity and discursive structures, we consider conditions for layering to include trust, learning and transparency to develop nascent networks. Similarly, control policies require legislative certainty, which means introducing new rules formalised by the government and enabling the selection environment for new entrants. In terms of infrastructure, layering means attaching new kinds of infrastructure to an

existing setup. In general, we consider layering to be a fluid process of blending different kinds of actors, networks and material resources over time.

Table 5.1: Operationalised concepts of regime-resistance and niche-challenge strategies in the selection environment

Regime selection environment dimensions	**Regime-resistance strategy**	**Niche-challenge strategy**
Markets	Delay market reforms	Forge new user-producer relations
Organisation capacity and networks	Enlist powerful existing network	Engender trust and learning
Discursive structures	Exploit information asymmetry	Seek information transparency
Public policies	Employ indecision and inaction	Lobby for certainty over new rules
Infrastructure	Stall reforms to infrastructural rules	Add new infrastructure to old

We used a range of data sources including qualitative in-depth semi-structured interviews supplemented with field notes, documenting remarks from interviewees, reflections and views throughout the fieldwork (See Appendices A and B). We then complemented these with secondary data by reviewing documents from government policies and strategies, scientific articles, books, doctoral theses and reports published in grey and academic literature (reviewing prominent analysts of South Africa's electricity system, e.g. Steyn, 2006; Steyn, 2012; Marquard, 2006; Eberhard and Gratwick, 2011; Baker, 2014; Baker et al., 2014). We also examined transcripts from parliamentary hearings of the Energy, Public Enterprises and Environmental Affairs

Portfolio Committee (See Appendix C). These were important for determining what was, and was not, articulated by high-ranking government officials and Eskom employees. These parliamentary hearings include representation by Ministers, Eskom board members, expert actors (prominent academics, policymakers, think tanks) and private sector companies. For triangulation, it was important that evidence derived from these data sources corresponded to determine the validity of claims. If some information had inconsistencies, these were evaluated against multiple sources of evidence such as interviews from different actors, and various public documents (See Chapter 1, Section 1, on triangulation issues). Lastly, prior to conducting the fieldwork, an ethical review was completed, which outlined that interviewees consented to provide information on a voluntary basis, and data could not be traced back to an individual participant.

Most of the primary research was conducted during fieldwork that took place from June to August 2015, and March to July 2016. In this paper, we draw and cite from 12 interviewees who provide a broad representation of views and knowledge about the South African case. The interviews took place in Pretoria, Johannesburg and Cape Town, and included actors from government, NGOs, the private sector, academia and think tanks. We analysed the transcriptions of the interviews according to the operationalised strategies of regime-resistance and niche-challenges, as indicated in Table 5.2. Each respondent was provided with questions that pertain to these strategies, dependent on their expertise (see Table 5.2*).* For analysis, we grouped the outputs from the interviews according to the selection-environment dimensions and triangulated these as far as possible with information from document analyses. Because of the sensitive nature of the topic, interviewees were informed at the beginning of interviews that they would remain anonymous, which also raised the potential to elicit more honest responses.

Table 5.2: Anonymised summary of interviewees and relevant concepts

Respondent	**Description**	**Focus**
A	Former Eskom Group Executive	Regime-resistance
B	Senior Government official served at the DOE	Regime-resistance and niche-challenge

C	Programme manager for a South African Think and Tank and former senior Government official	Regime-resistance
D	Senior Economist for a South African Think Tank	Regime-resistance and niche-challenge
E	The chief economist at a South African State-Owned Enterprise (SOE)	Regime-resistance
F	Director of a South African Think Tank	Regime-resistance and niche-challenge
G	EIUG member, and Manager in a Petrochemical company	Regime-resistance
H	Pricing Manager at an SOE	Regime-resistance
I	Senior Manager for a mining company and member of the EIUG	Regime-resistance
J	Independent contractor for RE I4P[12] and member of South African Photovoltaic Industry Association (SAPVIA)	Regime-resistance and niche-challenge
K	Senior Academic on energy and infrastructure at a South African university	Regime-resistance and niche-challenge
L	Independent consultant on the industry, trade, energy, and infrastructure policy	Regime-resistance

[12] The RE I4P is the Renewable Energy Independent Power Producers Procurement Programme – see Section 5.8.3.

5.7 Description of the socio-technical regime

Before presenting our case study, we briefly explain the socio-technical context of the incumbent. As mentioned, we conceptualise South Africa's electricity regime is embedded within the MEC and the state-owned electricity utility Eskom as its dominant incumbent. Here, we elaborate on the various elements of the MEC and then describe the position of Eskom within this and within the South African context, focussing mainly on the selection-environment dimensions discussed in Section 5.3. The MEC describes the reciprocal relationship of several industries that includes mining, the energy sector, supportive infrastructure and other related industries (Ting, 2015). Several scholars have noted shifts in the MEC in post-apartheid South Africa, particularly as existing coal mines are ageing and coal deposits are rapidly depleting (Burton and Winkler, 2014; Jeffrey, 2005). This has consequences on mining new geological sources, logistics, and market structure, all of which have an impact on the MEC (Trollip et al., 2014; Burton and Winkler, 2014).

Nevertheless, there are still mining and associated industries that rely on Eskom for their electricity, as the utility remains largely a monopoly. Thus, as long as Eskom remains a dominant incumbent, the utility has a crucial role in enacting the established rules and resources that have enabled the stability of a socio-technical regime related to mining and energy. Moreover, the country continues to rely on mining and the mineral sector, with mining contributing to around 7% of GDP, 25% of exports and accounting for more than 1 million jobs (Baxter, 2016). The biggest mining companies belong to an Energy Intensive Users Group[13] (EIUG), which together account for more than 40% of electricity demand (Ting, 2015).

Central to the MEC was the establishment of Eskom in 1923, and it continues to form a vital component for support of the mining industry (Marquard, 2006). Eskom has remained a vertical monopoly responsible for electricity generation (>90%), transmission (95%) and distribution (>50%) (Eskom, 2016b; Eskom, 2016a), deriving most of its revenue from three primary customers: redistributors through municipalities, industry, and large mining companies. Together, these three consumer-

[13] Energy Intensive Users Group (EIUG), www.eiug.org.za

categories account for approximately 80% of electricity consumption and revenues (see Figure 5.3), making them powerful sources of pressure to maintain the incumbent core rule for affordable electricity.

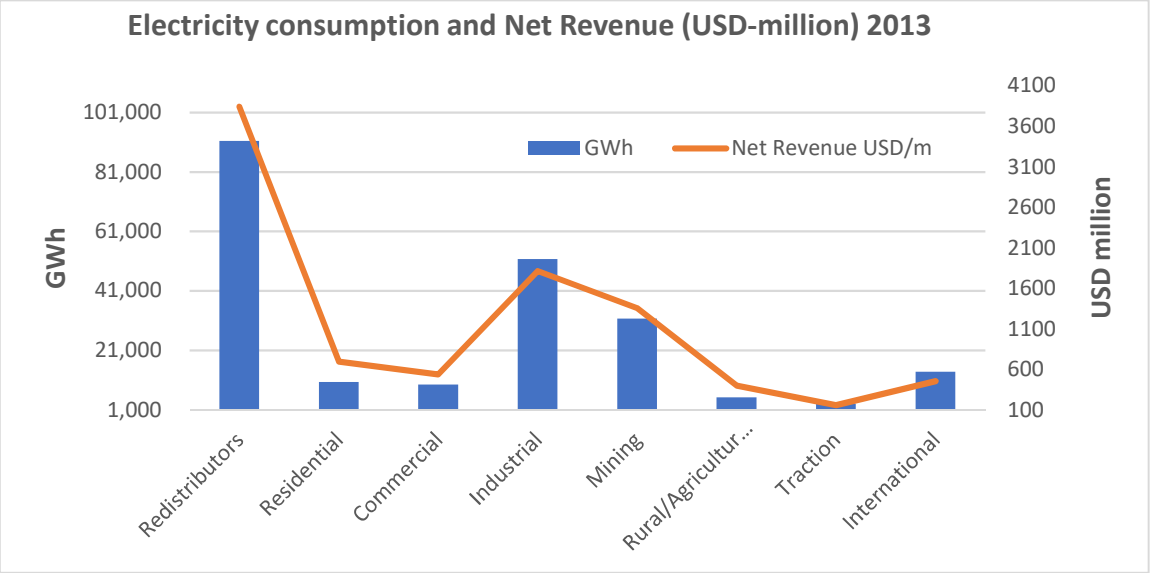


Figure 5.3: Eskom's main consumers by consumption and revenues

Source: NERSA (2015a; 2015b)

At present, Eskom is a state-owned utility, mandated to deliver affordable and accessible electricity, a critical developmental objective mainly due to an industrial policy of enabling mining activities and to provide for low-income households (Eskom, 2012). To ensure affordable electricity, the state has been providing significant financial subsidies to Eskom. Up to 2008, South Africa's electricity prices had been amongst the lowest in the world, but customers were paying below the cost of electricity production.

Due to the state's strong support for developmental objectives, Eskom is managed as a "quasi-government department" subject to politicians' influence over what objectives are prioritised and how resources are allocated (Steyn, 2012, p. 33). Moreover, according to interviewees[14], Eskom's precise accountability is unclear, rendering it subject to makeshift governance. It has been such a vital instrument in the state's policy directives that it has been described as the "vanguard of economic development" and a highly "successful technocratic enterprise" (Marquard, 2006, p. 161). These ideas form the current discursive structure that underpins the pressure to maintain Eskom's core

[14] Respondent A, B

rule as a reliable supplier of affordable electricity. However, it is also clear that the vagaries of political leadership and ideology significantly influence the operation of the electricity system, shaping many aspects of regime-incumbent's selection environment.

The institutional environment within which Eskom operates is not only conditioned by the state's ideology but is also subject to intense lobbying, with significant political pressure coming from interest groups. Besides, the current regulatory framework is weak with insufficient capacity to hold Eskom accountable, and the formal institutional structure around Eskom is, according to one interviewee[15], "a constant source of inefficiency due to its "multiple parents arrangement". Specifically, the institutional governance structure includes the Department of Public Enterprise (DPE) as the shareholder ministry, the Department of Energy (DOE) where energy policies are formulated, the National Treasury (NT) whose role is to provide sovereign guarantees and to ensure compliance to the Public Finance Management Act (PFMA), and the National Energy Regulator of South Africa (NERSA). Figure 5.4 depicts this institutional structure, showing Eskom's "multiple parents". In this sense, Eskom has a dual role in adhering to developmental objectives in keeping the electricity prices as affordable as possible (NERSA's mandate), while also conforming to the commercial discipline required by DPE and NT (dti, 2013).

As can also be seen in Figure 5.4, there are major interest groups and these include organised local government (South African Local Government Association, SALGA, and the Association of Municipal Electricity Undertakings, AMEU), and the Congress of South African Trade Unions (Cosatu) who are concerned with continued affordable electricity. There are also the vested interests of large industrial consumers, particularly the EIUG. The EIUG is a tight configuration of actors from Eskom, mining and associated industries. Electricity supply for mining consumers must be reliable and predictable, which necessitates close cooperation and coordination between the state and the energy intensive users. This close relationship between mining and the state has concentrated power in a small elite group.

[15] Respondent A

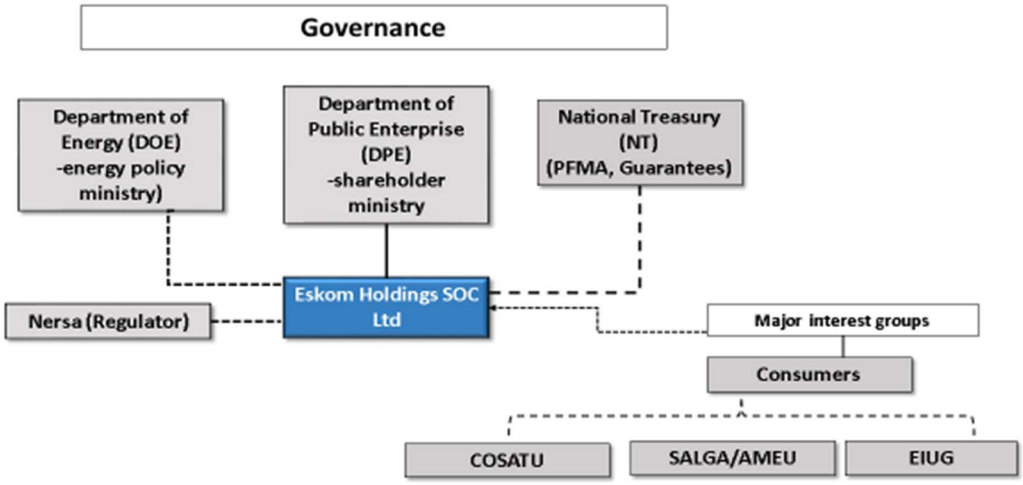


Figure 5.4: Institutional governance structure of South Africa's electricity system
Source: Eskom (Eskom, 2018; Eskom, 2016b)

Note: Eskom's shareholder Ministry (to which it is formally accountable) is the Department of Public Enterprise. This formal relationship is represented by a solid line. The dotted lines represent influences on Eskom. The darker dotted lines depict formal government structures (DOE, National Treasury, and NERSA), and the fainter dotted lines depict the influence of interests' groups.

Lastly, the country's electricity regulatory framework is weak. An independent electricity regulator has not yet been adequately established in South Africa because government officials do not entirely separate power and roles accordingly. Briefly, the National Energy Regulator (NER) regulated the electricity industry from 1995 to 2006. During this time, NER was meant to be independent of Eskom but was initially staffed with ex-Eskom personnel (dti, 2013, p. 25; Eberhard, 2007). In 2006, NERSA replaced NER but was mostly reliant on cost calculations presented by Eskom and, according to interviewees, has lacked the necessary capabilities or capacity to challenge Eskom's dominance[16] or interrogate its data[17]. This creates a huge information asymmetry between Eskom and NERSA. As another interviewee[18] commented, "Eskom can bury their information in

[16] Respondent C
[17] Respondent D
[18] Respondent E

reams and reams of data, and it is very difficult for the regulator to pull things out". Moreover, yet other interviewees observed that "NERSA is politically weak"[19] and "there was this sense that Eskom had regulatory capture for some time"[20].

Moreover, the DOE determines the generation capacity that is to be procured, and this is often subject to political decisions, and Cabinet approval, without due scrutiny from the regulator. According to one interviewee[21], "there are cases that Eskom investment plans, planning methodology, and assumptions are developed confidentially without evaluation by NERSA but are approved by Cabinet", and that "decisions [by NERSA] are made on an 'ad hoc' basis that is mindful of tensions between political and economic pressure, as opposed to a transparent and predictable methodology" (Steyn, 2012, p. 33).

It should be clear from the preceding that NERSA is a weak and ineffective regulator, and this will tend to favour Eskom because there are insufficient mechanisms in place to control its actions. Overall, as an interviewee[22] observed, it is difficult to prioritise between the numerous directives Eskom receives, especially under conditions with many competing variables. In general, the primary interest groups provide strong motivation for keeping the status quo, and for Eskom to maintain its status as a monopoly utility and the core set rules of cheap electricity.

5.8 Case study analysis

Having described the MEC and Eskom's place within it, we now present the case study. Each sub-section begins with a paragraph summarising the main events or features of the period covered, followed by a more detailed historical account of these events and features. At times, we reflect the various developments back to the elements presented in our conceptual framework.

[19] Respondent D
[20] Respondent G
[21] Respondent F
[22] Respondent A.

5.8.1 1998-2006: Energy sector reforms

We begin our case study by discussing the period 1998 to 2006, during which the country's electricity sector was the focus of significant reform efforts. A key turning point was the proposed introduction of private sector participation in 1998, creating a fundamental threat to Eskom's monopoly status. In 2006, two new coal plants were commissioned, and a change in pricing methodology resulted in significant electricity tariff increases. These changes are essential to review because they provide contextual discontinuity for Eskom, making it increasingly difficult to maintain its core rules. Eskom's responses to these changes – delay of market reforms and initiating debates away from public scrutiny – demonstrate its initial resistance strategy.

The 1998 Energy White Paper proposed unbundling Eskom, indicating new electricity generation would be produced by the private sector, thereby threatening a fundamental shift in its monopoly status. There were indications that South Africa's electricity system would adopt a competitive wholesale market as part of its market reforms (dti, 2013, p. 29), and the policy transferred the power of securing investment for new generation capacity from Eskom to the Department of Minerals and Energy (DME) (Trollip et al., 2014). Concurrently, the Energy White Paper and subsequent Integrated Energy Plans indicated that the country was heading towards an electricity deficit by 2008 (DME, 1998).[23]

From 1998 to 2004, the tight supply was due to major policy uncertainty at the time, as well as Eskom's inability to fully comprehend the impending electricity deficit. The policy debate centred on uncertainty regarding the electricity market reform, due to undefined market rules, an immature regulator and an ideologically-based belief in parts of the government that private sector involvement would raise electricity prices beyond the affordability of most South Africans (dti, 2013). Eskom contributed to the policy uncertainties and confounded decision making as it downplayed fears of the impending generation deficit by returning-to-service previously mothballed plants (dti, 2013).

[23] The Department of Minerals and Energy (DME) was split in 2009 to form two Ministries: the Department of Energy (DOE) and the Department of Minerals and Resources (DMR).

As a consequence, Eskom's proposed solutions were highly inaccurate planning assumptions such as inadequate maintenance plans, and low estimation of the costs of unserved energy (Newberry and Eberhard, 2008, p. 61). Eskom's responses are instances of 'cognitive lock-in' (as in cognitive rules guiding actor's behaviour, as mentioned in the opening of 5.3.2), where this influences the discursive structure such that an incumbent typically persuades decision makers to maintain the status quo. Cognitive lock-in includes taken-for-granted beliefs, where an incumbent tends to search for incremental solutions, insensitive to new development outside their own focus (Geels and Schot, 2007).

As Eskom contributed to the lack of clarity that was required for the system to adapt to the changes, the government reversed its decision to implement private sector generation. By 2005, with the electricity deficit in sight, Eskom's resistance strategy – inaction and lack of compliance – had seen it successfully maintain its market dominance. Moreover, by this time, attempts to implement a competitive wholesale market were abandoned, ensuring Eskom remained a monopoly in the form of a compromised Single Buyer Model (SBM), tasking Eskom as the buyer of subsequent future generation capacity (dti, 2013). The SBM forms a crucial component for ensuring the continuance of Eskom's core rules. Subsequently, from 2005, Eskom was tasked to build two new coal plants – Medupi and Kusile – with a combined capacity of 9.5 GW (Trollip et al., 2014).

To finance the new coal plants, from 2006, the DOE changed Eskom's pricing methodology in an effort to head towards cost reflectivity, changing Eskom's core rule of providing cheap electricity. Eskom required NERSA's approval of electricity price increases through the Multi-Year Price Determination (MYPD), a strategic phased-in approach that would lessen the impact of short-term electricity price increases against the country's long-term economic and social goals. The MYPD covered 3-5-year cycles from 2006 up to 2018 (Eskom, 2012) (see Figure 5.5 for details).[24]

[24] Respondent E, H

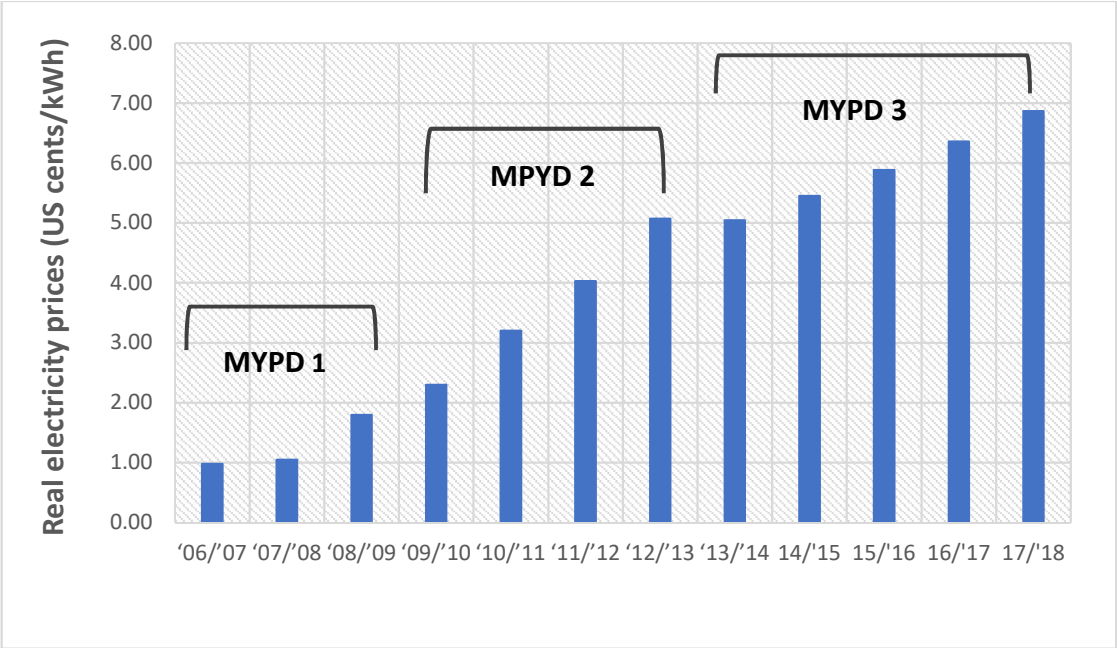


Figure 5.5: Eskom's Multi-Year Price Determination (MYPD)
Source: DOE (2013b) and NERSA (2015b)

Note: MYPD 1= 2006-2009, MYPD 2= 2009-2012, MYPD 3=2013-2018

5.8.2 2007-2009: Major electricity crisis

From 2007, there was a continued delay in responding to the impending electricity deficit, resulting in a major electricity crisis in 2008. This opened a window of opportunity for renewables and, by 2009, NERSA introduced a renewable energy feed-in tariff (Refit). However, because of institutional conflicts, implementation of the Refit failed soon after and attempted to redress the electricity shortfall through private sector participation also failed. Once again, Eskom's resistance strategy enabled its continued market dominance, and we see the difficulties of implementing coherent generation policy because of the complicated but weak institutional structure.

Due to long lead times, commissioning the new coal plants in time was not achieved, nor were the return-to-service mothballed plants sufficient to ward off the electricity shortfall. By 2008, a major electricity crisis occurred, causing regular blackouts. Eskom, in this period, had contributed to a complex set of inaccurate planning assumptions that included inadequate maintenance plans and underestimation of the costs of unserved

energy[25] (Newberry and Eberhard, 2008, p. 61). Hence, the crisis was an internal accumulating pressure over time, worsened by Eskom's persistent defiance and indifference.

As the electricity crisis deepened, Eskom's core rule of 'supplier of last resort' was under threat and indicators of its operational performance were worsening.[26] Two indicators, in particular, are indicative of plant performance: Energy Availability Factor (EAF) and Unplanned Capability Loss Factor[27] (UCLF). The EAF was already in decline, falling from 92% in 2001 to 85% in 2008 and, as Figure 5.6 shows, continued to decline to 70% in 2015. Meanwhile, the energy lost due to unplanned interruptions, as measured by the UCLF, was also worsening. In 2001, the UCLF was 2%, but this had risen above 5% by 2008 and continued to increase after that, reaching 15% in 2015. Therefore, Eskom had an internal accumulating operational challenge over time. The weakness in performance parameters and the steep tariff increases were together an indication that Eskom was losing its ability to provide both reliable and cheap electricity. Along with the electricity crisis, this prompted a search for alternative solutions, opening a window of opportunity for niches such as renewables to provide solutions to the electricity deficit.

[25] Cost of unserved energy (COUE) is an important measure of the detrimental impact to the economy of energy that is not reliably supplied. By estimation, the COUE in 2013 was calculated around 6 USD per kWh. For more see NERSA NERSA 2015a. Consultation paper on Eskom Cost of Unserved Energy (COUE). Pretoria: National Energy Regulator of South Africa..

[26] Respondent L

[27] EAF measures plant availability, plus energy losses not under the control of plant management (external). UCLF measures the lost energy due to unplanned production interruptions. For comparison, an acceptable EAF would be above 80%, and an acceptable UCLF would be below 5%.

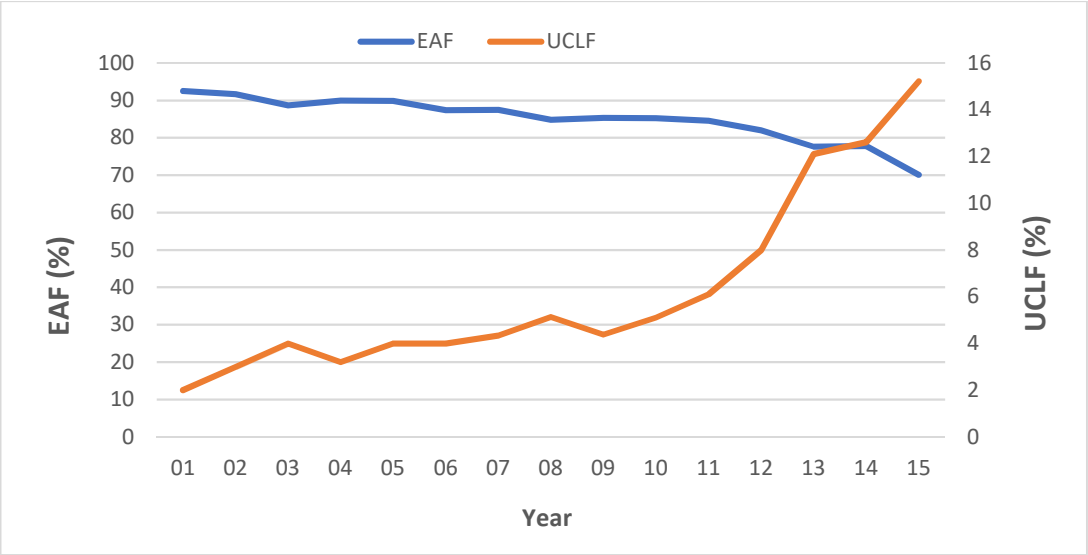


Figure 5.6: Eskom plant performance indicators EAF and UCLF, 2001 to 2015
Source: Eskom (2008; 2015a)

From 2008, as the electricity crisis intensified, the DOE continued to initiate calls for independent power producer (IPP) bids. However, Eskom – responsible for concluding the bids – repeatedly delayed decisions that would conclude preferred IPP bidders for co-generation, baseload projects and the medium-term power purchase programme (Eberhard, 2014a). Examples include failed opportunities to contract additional IPPs for an 800 MW Kudu gas-to-power plant in Namibia and, in 2009, a Mmamabula 1200 MW coal contract from Botswana (Eberhard, 2014a). Within South Africa, 125 qualifying bids totalling 4900 MW failed to obtain contracts from Eskom (Eberhard, 2014a). This demonstrates that Eskom was determined to persist with its resistance strategy, holding on as much as possible to its core rules by delaying market reforms and playing-down the need to close the generation deficit. Eskom used its dominant position in the electricity sector to effectively hold-off the participation of IPPs, successfully stifling private sector participation and retaining its market dominance.

In 2009, in light of the electricity crisis, the DOE amended the Electricity Regulation Act (ERA) in order to prepare for a large-scale renewable energy project with private sector developers (more in Section 5.8.3). Around the same time, NERSA initiated the Renewable Energy Feed-in Tariff (Refit), which it had been developing since 2007. However, NERSA overstepped its mandate as it initiated upfront legally-binding tariffs ahead of the DOE, and there was also uncertainty in the process of procurement and

licensing, and financial assumptions (Eberhard and Kåberger, 2016; Baker, 2014). Consequently, from 2009-2011, the DOE and National Treasury took the lead with a series of informal consultations from the private sector, and lawyers and financial institutions dealing with renewable energy. Through these consultations, a crucial feedback and learning process transpired, with the design, legal and regulatory framework and technological details being discussed (Eberhard and Kåberger, 2016). Subsequently, a competitive bidding process called the Renewable Energy Independent Power Producers Procurement Programme (RE I4P) was launched by DOE from August 2011, while NERSA ceased the Refit (Eberhard and Kåberger, 2016). Despite the withdrawal of Refit, its development process had the effect of widening participation, interests and learning in the electricity sector. A similar process unfolded in the development of the RE I4P, and the two processes combined formed an essential platform on which the RE I4P could later build, as we discuss in the next section.

5.8.3 2009-2015: Layering of the RE I4P

From 2009 onwards, the new pricing methodology (discussed in Section 5.8.1) resulted in significant tariff increases. This had the effect of challenging Eskom's ability to maintain its core rule of providing affordable electricity. This period marked a significant window of opportunity, with the successful layering of a new institution – the RE I4P – that promoted renewables. We describe this layering process here, examining the conditions that could explain why it was successful. The success was due, we argue, to a combination of a sufficiently developed niche and a transparent RE I4P bidding process that entailed greater involvement of actors external to the regime-incumbent (e.g. private sector, and greater public participation). This led to the rapid implementation of the RE I4P, followed by significant deployment of renewables and in turn steep reductions in their bid prices. During this period, it seemed, Eskom's resistance strategy was failing, and the renewables niche was becoming a threat to its dominance.

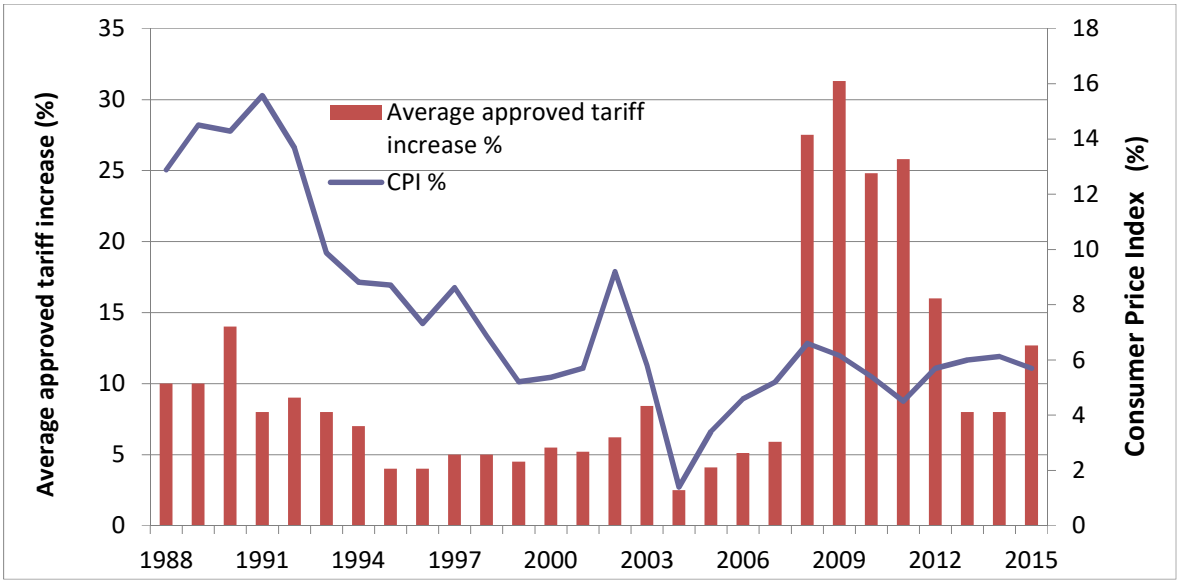


Figure 5.7: Eskom's average approved tariff increases relative to the consumer price index (CPI)
Source: Eskom (2015b; 2015a, p. 2)

As the pricing methodology changed, the average tariff-increase from 2009 to 2012 was consistently above the inflation rate. From 2009 to 2015, cumulative tariff increases were over 100% causing major price shocks, and extensive criticism from residential and industrial customers not accustomed to such changes (Figure 5.7). Indications were that Eskom could no longer provide cheap electricity and, therefore, its core rules became increasingly challenging to maintain. Therefore, Eskom was experiencing a period of instability, resulting in regime tensions.

As the MYPD was implemented, NERSA subjected Eskom to public hearings, exposing it to open and visible scrutiny of its operations. Thousands of responses were received from the public after NERSA invited comments on Eskom's proposed MYPD3[28] , and these were crucial in securing gradual tariff increases (dti, 2013, p. 153). However, whilst open discussions were taking place between the public and NERSA, another

[28] See "Invitation for stakeholders to submit written comments on Eskom's third Multi-Year Price Determination (MYPD 3) application", available at [accessed 1 August 2018] http://www.nersa.org.za/Admin/Document/Editor/file/Notices/Invitations/Invitation%20to%20comment%20on%20Eskom%27s%20Third%20Multi-Year%20Price%20Determination%20%28MYPD3%29%20application.pdf

debate was taking place out of sight between the EIUG and Eskom, as an EIUG member[29] explained:

> "The EIUG made sure to decline [NERSA] public hearings, as we do not want to be seen as a lobby group. Instead, we make it clear that we are a technical, fact-based group. As a group that has skin in the game, we do not want to strain Eskom relationship unnecessarily. We recognise that Eskom is our main electricity supplier, and maintaining relationships is important. This strategy of providing technical reports to Eskom and sharing it without public scrutiny has worked for us."
>
> Respondent I

Here, we observe that the close relations between Eskom and EIUG enabled information asymmetry between them and the public. Eskom was able to make use of the regime's organisational networks and capacity to engage in the regime-internal debate using privileged information and resources, further allowing it to realise its resistance strategy.

As the electricity crisis continued to grow, the window of opportunity for renewables widened. In 2009, in a layering process, the DOE ratified an amendment to the Electricity Regulation Act to introduce the New Generation Capacity (Trollip et al., 2014). Then, in 2011, this layering process continued with the introduction of the RE I4P, which allocated 17.8 GW of new renewable energy generating capacity by 2025 (DOE, 2015b). We can describe the RE I4P as layered because it co-exists alongside Eskom's single buyer model, but does not attack Eskom's position directly nor replace it: Eskom retained its dominant position because it maintained control over what electricity it was buying.

The RE I4P was able to build on the failed previous efforts such as the Refit, as those who had been part of Refit were still present. Geels and Schot (2007) argue that a niche must be sufficiently developed before it can exploit a window of opportunity opening in a regime. In this sense, the renewables niche might have been sufficiently developed to take advantage of the RE I4P in contrast to what it was able to achieve under Refit.

[29] Respondent I

However, beyond the readiness of the renewables niche, other conditions might have helped the RE I4P to succeed in comparison with the Refit. RE I4P's layering entailed transparent bidding windows, with the public being informed about the successful bidders and what the criteria were (Eberhard et al., 2014; Eberhard, 2016). Moreover, the IPP office within the DOE was decisive in gaining supportive partnership and cooperation between the DOE and National Treasury, mitigating Eskom's dominance by exploiting the IPP office's ambiguous institutional status (Eberhard et al., 2014). The IPP office is an ad hoc entity within the DOE, staffed by more than one hundred private consultants with less than a handful of permanent staff from the government (Eberhard, 2016). However, the staff in the IPP office have, according to an interviewee[30], respected experience in public-private partnerships. This enabled mutual trust and relative ease of information flow between the IPP office and private sector to test the bidding process before its implementation.[31]

Moreover, the somewhat successful introduction of the RE I4P did not require, nor did it result in, a complete destabilisation of the regime incumbent. Instead, the RE I4P and the burgeoning renewables niche co-existed alongside the dominance of Eskom. Explaining the success of renewables in this period compared with prior efforts includes recognition of the readiness of the niche, developed in part under Refit, and the fact that the RE I4P was implemented in a highly transparent manner. This had the effect of undermining Eskom's resistance strategy by shifting some of the debate into the public domain, resonating with the Hacker et al. (2015) notion that shifting contestation into the public arena enables the development of dissenting or alternative narratives. In other words, the electricity crisis and the RE I4P layering did precisely what regime actors were trying to avoid: contestation was now out in the open, resulting in the scrutiny of the incumbent's actions, along with increased availability of information through the transparent bidding process.

It can be argued that, in the context of a persistent electricity-supply crisis, the combination of institutional capacity in the IPP office and the rapid deployment of renewables led to steep reductions in their bid prices (Eberhard, 2014; Steyn et al., 2017;

[30] Respondent K
[31] Respondent K

DOE, 2015b). Up to 2015, South Africa had procured approximately 5 GW in four bidding windows across 77 renewable energy generation projects (Sovacool et al., 2018; DOE, 2015a). Further, as Figure 5.8 shows, the bid prices reduced significantly in this period, especially for solar PV, becoming competitive with the new coal plants Medupi and Kusile.

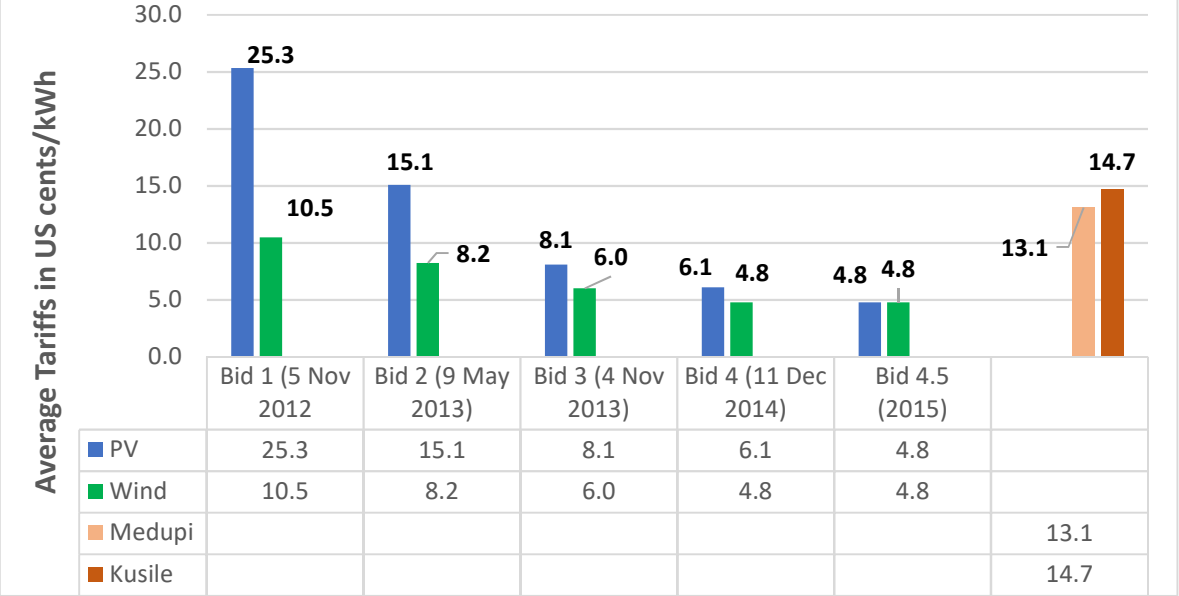


Figure 5.8: Average tariffs of PV and wind over time, compared with Medupi and Kusile Source: DOE (2015a) and Steyn et al. (2017)

5.8.4 2015-2018: Evolution of Eskom's resistance strategy

By 2015, the RE I4P had gained enough traction that Eskom began to accept the renewables niche as an inevitable reality. However, as we discuss in this sub-section, Eskom continued to pursue its resistance strategy and even to evolve it. It delayed the progress of the RE I4P by blocking power purchase agreements (PPAs), changing its grid-connection rules, and stimulating the support of influential trade unions to provoke sentiments around job losses from decommissioning coal plants. Moreover, there are claims that Eskom has become a tool for graft, in which procurement allocations are being redirected to benefit powerful elites (PP, 2016; Budlender, 2017; Bhorat et al., 2017). This demonstrates the significance of Eskom amongst its organisational networks and prevailing discursive structures, which may have reasons to maintain the state-owned utility's dominant position.

Eskom, in 2015, used its monopoly status to block the signing of PPAs with RE I4P developers (Eskom, 2015a). It did so by preventing the developers from getting budget quotes, which had the effect of stalling the finalisation of PPAs. Without these further PPAs, the RE I4P was incomplete and, as an interviewee[32] explained, this had created uncertainty around the programme. Here, we see Eskom's resistance strategy effected through delaying tactics and through information asymmetry, whereby others within the electricity system are prevented from scrutinising its data (Makgetla, 2016). In addition, from July 2016 onwards, Eskom discontinued detailed weekly operational efficiency reports that included demand and capacity forecasts. Publishing these updates annually seems to have an effect of decreasing public transparency.[33]

Later, Eskom's resistance strategy continued to advance, creating another barrier to the RE I4P by imposing additional grid-connection costs on RE developers. Essentially, the RE I4P developers are supposed to pay for 'shallow' costs of getting power to the substations, while Eskom is responsible for 'deep connections' that relate to the reinforcements needed to integrate new capacity into the existing grid (Eskom, 2013a). As an interviewee[34] explained, an unfortunate design of the RE I4P is that the bidding system prioritises the allocation of RE I4P by price and not by substation capacity or location. The transmission grid originated from the coalfields in the Mpumalanga in South Africa's North East and expanded according to where the cities grew. However, the Northern Cape has the best solar radiation, located on the North-Western side, where the population is sparse, and thus grid transmission is lacking. As the RE I4P was implemented, the project developers had to bid within an available substation capacity. The policy objective was to obtain the cheapest megawatt possible, without long-term consideration for grid strengthening. After several years of the RE I4P, the substation availability for connection was quickly depleted. It can be argued that the DOE and NERSA had probably failed to anticipate the rapid implementation of the RE I4P, and therefore neglected the costs needed for Eskom to strengthen the grid. Eskom exploited

[32] Respondent H.
[33] Respondent E
[34] Respondent J

this flaw by imposing additional costs on RE I4P developers, which had the effect of further complicating the progress of the renewables programme.[35]

Consequently, Eskom created unfavourable (to the niche) selection-environment conditions along with the technology and infrastructure dimension, impeding the RE I4P from further development.[36] Altogether, as Eberhard (2016) observes, "Eskom frustrates the entry of IPPs and private investment through the disingenuous use of facts, the political brinkmanship and what lawyers term malicious compliance, through the quiet subversion of government policy by actions such as delayed access or inflated grid-connection costs for IPPs."

Eskom continued to impede the progress of the RE I4P with a further evolution of its resistance strategy, this time by provoking opposition to renewables from the country's major trade unions – the National Union of Metalworkers of SA (NUMSA) and the National Union of Mineworkers (NUM). Eskom stated that to continue with the RE I4P, it needed to hasten the decommissioning of five older coal stations.[37] Consequently, the NUM countered with rolling mass action (such as nationwide strikes) to reverse the RE I4P because of the threat to coal jobs. As of January 2018, the RE I4P was at an impasse, with Eskom repeatedly stating that the programme was unaffordable. In response, RE I4P developers initiated lawsuits forcing Eskom to conclude PPAs.[38]

Eventually, after almost three years where the RE I4P remained stuck, in April 2018, the remaining bids were signed by a new DOE Minister, partly due to a broader change in national political leadership. This is evidence of the 'makeshift' governance we noted in Section 5.7, which is highly sensitive to the political weather and contributes to uncertain conditions in the electricity system. Consequently, with these erratic conditions, Eskom can respond to decisions that do not suit its interests either passively or more offensively using powerful allies. Moreover, with this ad hoc governance, it is

[35] Respondent D, J.
[36] Respondent K
[37] van Rensburg, D., 'New twist in IPP battle as Eskom may close stations early', fin24, 9 April 2017, http://www.fin24.com/Economy/Eskom/new-twist-in-ipp-battle-as-eskom-may-close-stations-early-20170407 Accessed 15 February 2019
[38] Coen, M. and Bruckhardt, P., 'Eskom threatens fastest renewable expansion', Mail & Guardian, 6 December 2016, https://mg.co.za/article/2016-12-06-eskom-threatens-fastest-renewable-expansion Accessed 1 February 2018

unclear how the RE I4P proceeds, as progress is subject to ongoing decisions by government on Eskom's future. For now, it is too early to ascertain if Eskom's resistance strategy will continue to undermine the RE I4P or if there could be long-lasting changes through which Eskom's dominance is eventually eroded.

5.9 Discussion

By examining struggles over rule-changes to a multi-dimensional selection environment, we were able to reveal the dynamic nature of regime-resistance and regime-niche interactions. Furthermore, in agreement with Streeck and Thelen (2005), examining endogenous institutional change was useful for exposing the regime tensions that, in the case of South African electricity-supply, ultimately contributed to the crisis. In this way, we were able to discern the internal regime-resistance strategy, which would otherwise be overlooked from a traditional punctuated (exogenous) equilibrium point of view.

In our case study, Eskom sought to maintain its long-standing dominance primarily by using a strategy of resistance to rule-changes, attempting to achieve what endogenous institutional change theory calls drift. In this theory, drift – as 'holding on to rules' – is enabled when powerful actors can confine debate over rule-changes to hidden spaces, disabling public scrutiny and, in effect, disarticulating contesting narratives. Our adaptation of the drift concept involved translating it to the notion of a socio-political regime, which theorises debate to be conditioned by discursive structures comprised of prevailing ideologies and beliefs. In our rendering of the drift concept, we posited that a regime-incumbent is more likely to maintain existing discursive structures and so can set the terms of the debate.

The period up to 2009 in our case study supports the proposition that a resistance strategy is enabled when a powerful actor can confine debate over rule-changes to hidden spaces and has a dominating influence over the terms of the debate. During this period, Eskom kept the deliberation about electricity-market reforms out of the public gaze, aided by those users closely connected to it within its organisational networks, especially those aligned with the MEC, such as the EIUG. As for setting the terms of debate, Eskom employed several tactics to maintain dominance over discursive

structures including downplaying fears about the anticipated electricity-supply deficit and exploiting both information asymmetry and the 'multiple parents' arrangement of the governance institutions. We also see the resistance strategy having material consequences in Eskom's inaction over PPAs and the eventual suspension of market reforms. However, our theoretical propositions were not so clearly supported in the case from 2009. Here, we see Eskom was still able to affect a resistance strategy even though the debate shifted into public contestation, as the renewables niche made significant material gains.

Reconciling the apparent anomaly between our theoretical propositions for drift and the observed outcomes requires considering what is revealed by the attempts to layer-on renewables-supportive institutions. We conceived layering to mean the addition of an institution that does not challenge, at first, the core rules of the regime. The first attempt at market reforms could be seen as a challenge to the regime incumbent's core rules, and therefore not a layering process, as the intention was to unbundle Eskom and stipulate the private sector produce 30% of electricity generation. What followed was a single buyer model, where Eskom retained its monopoly status, ensuring its continued dominance in the electricity market. Thus, the attempted introduction of Refit conforms more closely to a layering process in that it was not a direct and significant challenge to Eskom's core rules.

Nevertheless, it was unclear whether Eskom would fully support Refit or continue with its resistance strategy of delaying any PPAs needed for Refit's implementation. In the end, Refit's failure had less to do with Eskom than with battles between the electricity governance institutions – DOE, National Treasury and NERSA – and Refit's uncertain legality. However, the Refit episode did stimulate some important development of the renewables niche. It linked new actors – renewable energy project developers, lawyers and financial institutions – with the electricity regime's governance institutions. The consultations amongst these new actors and the governance institutions began the process of building trust and creating learning around what policy and regulatory frameworks would be needed to support renewables deployment. By engaging new actors who could now exert some influence over the regime's discursive structure, Refit

began a process of changing the selection environment, even if only partially and incrementally, opening a space that the RE I4P was able to expand and exploit.

The eventual layering of the RE I4P was preceded by a process that included further consultations between the electricity governance institutions and actors in the renewables niche, which enabled the building of mutual trust and learning about the design, legal and technology issues relevant to the proposed bidding process, along with testing of the bidding process prior to its implementation. All this occurred in the context of a widening window of opportunity created by the electricity-supply crisis and steeply increasing electricity tariffs. Both these aspects of the window of opportunity were in effect attacks on Eskom's core rules – in some ways, self-inflicted attacks, considering Eskom's resistance strategy and its intention to finance new coal plants through raised electricity tariffs. We see, then, new actors strengthening their relations with the regime's governance institutions and growing influence over its discursive structures resulting in the successful addition of a new rule that would enable significant gains for the renewables niche (for more see [Parliamentary Monitoring Group] PMG (2011; 2012; 2018). However, because of the prior gains under the failed Refit effort, the renewables niche was sufficiently developed to exploit the window of opportunity more effectively.

Although the RE I4P managed to stimulate the addition of significant renewables capacity to the electricity supply, Eskom returned to its resistance strategy of delaying the finalisation of PPAs, this time by exploiting its monopoly position when it withheld budget quotes. However, Eskom also evolved its resistance strategy by attempting to influence beliefs within the dominant discursive structure when it threatened the loss of jobs for coal workers because decreasing the contribution of coal-fired electricity generation would mean the closure of coal mines. Here, we see Eskom itself had moved contestation into the public arena, making use of its powerful position on four dimensions of the regime selection environment: organisational networks (mobilising key trades unions), discursive structures (information asymmetry, the job-losses narrative), markets, and public policies (delayed finalisation of PPAs). Moreover, the other element of its resistance strategy involved making use of the uncertainty over

infrastructural rules, such as who is responsible for the costs of new substation capacity, to impose extra costs on RE I4P developers.

Taken together, we have revealed the dynamics of regime-resistance to niche-challenges as played out between the incumbent Eskom and renewables actors in the battle over rule-changes to South Africa's electricity supply system (see Table 5.3 for a summary). Not only does this help us understand how Eskom has sought to maintain its dominance and how renewables have been able to make some inroads to the regime, but it also provides potential implications for policies aimed at sustainability transitions.

Table 5.3 A summary of the case study and the types of regime resistance and niche challenges over time

Case study period	Regime-resistance	Niche-challenges
1998-2006 Energy sector reforms	Eskom used its power over the regime's discursive structure to persuade decision makers to maintain the status quo.	There was no appreciable niche at the time as this was only the early stage of renewables development. Consequently, we see no discernible niche challenges.
2007-2009 Major electricity crisis	Eskom blocked market reforms through delayed decisions in contracting IPP bidders.	Refit was initiated, catalysing learning processes associated with the design, technical, legal and regulatory framework needed for promoting renewable energy in South Africa.
2009-2015 Layering of the RE I4P	Eskom tried to keep electricity-sector debates hidden from public scrutiny by making use of its organisational networks and capacity.	The RE I4P was implemented in a transparent manner, shifting debate into the public domain. This influenced the regime's discursive structure, changing the terms of debate by introducing new facts and gaining public support.
2015-2018 Evolution of Eskom's resistance strategy	Eskom moved debate into the public domain, provoking key trades unions in its organisational	Niche actors engaged in policy debates, strengthening their relations with the regime's

	networks to engage in industrial action by promoting a job-losses narrative. It also delayed finalisation of PPAs and changed the grid rules to impose extra costs on niche actors.	governance institutions, resulting in growing influence over the regime's discursive structure.

Policymakers could, for example, use the approach to characterise the power of specific incumbents to resist transitions and then use this characterisation to construct strategies for eroding this power in favour of more sustainable regimes. With reference to the selection environment dimensions, an effective destabilisation process could entail the following: (1) in the market, reducing the support for the incumbent technology (e.g. a final clarity on Eskom's unbundling as it may remove monopolist interest that is hostile to IPPs); (2) disrupting organisational networks and capacity by promoting more inclusive participation of niche actors in policy debates, and establishing organisations that favour new entrants with systemic linkages into formal governance structures; (3) developing alternative discursive structures by creating conditions that interrogate dominant narratives, working in spaces that are transparent (e.g. opening up debates to more public scrutiny and divergent interests); (4) ensuring public policies create regulatory pressure to, for example, reduce greenhouse gases; and (5) adapting technology and infrastructure rules to favour modular generation with flexible demand and distributed energy networks. Working across all these dimensions together would then be a systematic and targeted process towards regime destabilisation along with the promotion of more sustainable niches.

5.10 Conclusion

In this paper, we have analysed how the dominant incumbent in South Africa's electricity system, Eskom, tried to resist changes to the system's institutional arrangements that would promote the renewable energy-based generation and therefore be detrimental to its coal-based interests. Drawing on the modes drift and layering from institutional change theory, we operationalised the concept of the socio-technical regime selection environment in specific ways that could be analysed as a battleground over rule-changes.

We found that, over the period 1998 to 2018, Eskom evolved its resistance strategy in response to variously successful challenges employed by actors in the renewables niche. Eskom's resistance strategy began simply with a refusal to implement electricity market reforms that would have eroded its market dominance. However, as renewables began to achieve incremental gains from layering-on rule-additions to the existing institutions, Eskom evolved its resistance strategy by acting across more of the selection environment's dimensions. Eventually, Eskom's strategy involved attempts to publicly-contest the rise of renewables, which included exploiting information asymmetries to influence public discourse and provoking mining unions to engage in industrial action. However, the move to publicly-contest renewables opened Eskom to closer scrutiny, with opportunities for the renewables niche to influence the discursive structure of the selection environment and the eventual addition of the Renewable Energy Independent Power Producer's Procurement Programme, which has enabled an increase in renewables generating capacity of 3.6 GW (DOE, 2018a).

The case study shows that regime-resistance can be characterised as the incumbent actively maintaining the selection environment in response to attempts on the part of the niche-challenger to transform it. These findings have potential policy implications where specific dimensions of the selection environment that enable or enhance regime-resistance can be identified. In doing so, counter-strategies can be developed that achieve some degree of regime destabilisation and thereby open a window of opportunity for a more sustainable niche to exploit. We note, in particular, the significance of influencing the selection environment's discursive structure where, in the case study, we saw how the niche was able to change the terms of debate, exacerbate regime tensions and gain public support. These insights emerge from only a single case study and so further research, making use of the multi-dimensional selection environment concept and analysing regime-resistance and niche-challenges, would be helpful for seeing the extent to which similar dynamics play out elsewhere and in other kinds of regimes. Such research could take a systematic approach to examine battles over rule-changes, building case studies that compare different types of institutional change that hollow out the regime, with the potential to lead to a genuine sustainability transition.

CHAPTER 6

Paper 3: Multiple Regime Interactions, Conversion, and South African Liquefied Natural Gas

This Chapter has been published as a working paper: TING, M. B. 2019. Multiple Regime Interactions, Conversion, and South Africa's Liquefied Natural Gas. *SPRU Working Paper Series (SWPS),* 08**,** 1-30.

6.1 Abstract

Increasingly it is recognised that regimes in transitions can promote niches rather than resist them. Using a combination of the Multi-Level Perspective (MLP) and institutional theory, this paper contributes to the transitions literature on multiple regime interactions, by providing a more nuanced understanding of why and how regimes interact over time. Using semi-structured interviews, the case study explored South Africa's development of its Liquefied Natural Gas (LNG) for power generation and industrial use together, considered as the niche. The two regimes were coal-based electricity and liquid fuels. This case study revealed the co-evolutionary nature of multiple regime interactions through repurposing existing institutions in response to increasing landscape pressures and regime tension over time. However, the repurposing of existing rules was neither spontaneous nor automatic but required a series of cohesive efforts for linkages between the two regimes. These efforts involved the ongoing interface between a broad base community with interests in the LNG niche, which over time provided a supportive environment in which to complement shared resources. Understanding multiple regime interactions has potential implications on the 'acceleration' of niche development whereby new institutions are not necessarily created but rather repurpose existing ones to serve new goals or interests. The paper also reflects on temporal policy overlaps aimed at sustainability transitions where a policy instrument initially used for renewables could be co-opted by more powerful actors in a direction that may strengthen a fossil fuel-based system. Thus, special attention needs to be paid to the relationship between the flexibility of some policy instruments and the dominant groups which may leverage them for its own interests.

6.2 Introduction

This paper examines how multiple regime interactions enable the development of a niche through a series of cohesive efforts in repurposing existing regime rules. Understanding multiple regime interactions is essential in transitions research because it can counter the bias of bottom-up niche development (Geels, 2011), as well as standalone regime transformations (Papachristos et al., 2013; Raven, 2007; Sutherland et al., 2015; Konrad et al., 2008). Moreover, there is limited deliberation on the role of

landscape pressures, and regime tensions on multiple regime interactions, which are indeed central to sustainability transitions research (Sutherland et al., 2015).

To examine multiple regime interactions, this research presents a case study on South Africa's development of gas-fired generation in the electricity system and industrial use. In 2015, South Africa introduced an independent gas power producers' procurement programme (Gas I4P)[39], to procure 3.7 GW of liquefied natural gas (LNG) to power (DOE, 2016). At present, gas contributes around 3% of the country's primary energy mix, but there are indications that gas will feature more strongly in the future (DOE, 2018b).

Although gas is not carbon neutral, it is considered cleaner than coal, and it could enable reduced dependence on coal while other sources of renewables are being developed (Moniz et al., 2011). However, as this thesis will show, closing a 'gas bridge' may not be easy at it will mean having to deal with the vested interests and path dependencies by any gas-related socio-technical system.

Moreover, there are a diversity of drivers pursuing gas which are; energy diversification, as a means to reduce GHG emissions from electricity generation; as a potential to provide flexibility for the introduction of renewable generation into the electricity grid; and as an opportunity for regional trade within the Southern African Development Community (SADC) (DOE, 2016).

The research question is: What explains a regime's interactions in the course of developing South Africa's LNG for power and industrial use?

To answer this question, the case study uses the Multi-Level Perspective (MLP), whereby the two regimes are electricity and liquid fuels, and LNG for power and industrial use was considered a niche. As this paper aims to advance the concept of multiple regime interactions, the analytical work is based on analysing rule changes which are expected to reveal different types of regime interactions. It is well known in transitions research that regime actors are not passive rule followers but are 'knowledgeable agents' that can reflect and engage in ways other than their taken for granted social rules (Geels and Schot, 2010, p. 34). Given that rules are informed by institutional theory, this research

[39] For consistency Gas I4P is used throughout the paper.

draws on the concepts of conversion which observe the efforts employed by both regimes to develop a niche. The conversion was developed by institutional scholars and is defined as the repurposing or redirection of existing rules for new ends (Streeck and Thelen, 2005).

As discussed later, existing rules between the two regimes were repurposed over time, as a response to pressures from landscape changes and regime tensions. As such, viewed from a multi-level perspective, increasing pressures from the landscape and the electricity regime influenced the search heuristics from a local to distant search (Geels, 2014a, p. 271). In this way, it gradually integrated more radical alternatives and explorations of new knowledge bases. The South African case study demonstrated that to develop the LNG niche, several cohesive efforts of alignment between the electricity and liquid fuels regime became necessary. At first, the efforts involved repurposing an existing policy instrument which was initially used for renewable energy from an independent power producers' procurement programme (RE I4P)[40] but later procured gas and coal also from independent power producers (IPPs). Then, as the required technical and operational parameters needed for the LNG niche matured, so did the level of interaction between the two regimes. A series of activities followed which were premised on importing LNG for power generation and industrial use. Therefore, a broad base of actors became part of the LNG development, which included national and local governments, societal groups, finance, industry stakeholders, the environment and the research community. These served as a supportive and collaborative community on which the repurposing of rules became conceivable.

This paper argues that the repurposing of existing rules between regimes can provide insights for advancing the literature on multiple regime interactions which in turn has implications on niche development. The paper concludes with some reflections on the implications that policy instruments may be vulnerable to co-option by dominant groups that could re-direct them away from sustainable transitions.

The paper proceeds as follows. Section 6.3 sets out the conceptual framework and gives due consideration to the critical concepts of the conceptual framework, which is a

[40] For consistency the RE I4P, is used throughout the paper.

combination of the MLP with an institutional lens of conversion. Section 6.4 discusses the methodology used for the research; Section 6.5 provides an overview of South Africa's liquid fuels history, and electricity as regimes, describing how the multiple regimes emerged to create a favourable environment for the development of Gas I4P. Section 6.6 draws together the main findings in the paper and concludes in Section 6.7 with suggested contributions to the empirical and theoretical research.

6.3 Conceptual framework

6.3.1 Conceptualising multiple regimes in transitions research

The notion of transitions is regarded as co-evolutionary changes between socio-technical systems, actors and social networks, and socio-technical regimes (Foxon, 2011; Geels and Schot, 2010). One of the most common frameworks used in transitions research is the Multi-Level Perspective (MLP). The MLP defines transitions which interface changes at three levels: innovative practices (niche experiments), structure (the regime), and long-term, exogenous trends (the landscape) (Geels and Schot, 2010). The MLP considers the interaction between all three levels in a given time as part of the process of transitions (Raven and Verbong, 2007). These three levels are regarded as functional relationships between actors, structures, and practices that are closely interlinked. Furthermore, the higher the scale level, the more aggregated the components and the relationships, and the slower the dynamics are between these actors, structures and working practices (Grin et al., 2010).

The regime tends to lock in processes because of mutual interdependencies and alignment over time, such that path dependency and incremental change are likely (Smith and Raven, 2012). Where radical innovation does take place is in the form of protected spaces, so-called niches. Landscape changes, such as global trends or climate change concerns, may exert pressure onto the regime resulting in destabilising effects and for niches to develop. Transitions within the MLP frame start in socio-technical niches, and diffuse and breakthrough due to the linkages between developments at multiple levels (Geels and Schot, 2010). The assumption is that as a niche matures, it scales up and diffuses, resulting in overthrowing the incumbent regime, eventually leading to either transformation or replacement of the dominant regime. However,

there are other scholars who recognised that regimes also drive innovation at the niche level, depending on the economic opportunity (Berggren et al., 2015). For instance, in analysing hybrid electric powertrains, Berggren et al. (2015) noted that an incumbent, which drove innovation in a systemic, integrated approach, had good potential in scaling up niches such that technological applications had vertical integration and broader market adoption. To elaborate, incumbents used existing knowledge resources to leverage the development of new technologies and applied innovation across a variety of market segments, as well as providing insights into performance requirements such as efficiency, functionality and costs. In this way, the incumbent took advantage of existing resources to support and develop the technological niche.

Moreover, standalone regime transformations have been criticised given the interrelatedness of complex sociotechnical systems (Papachristos et al., 2013). As such, a few researchers have revealed various ways in which multiple regimes can interact, and these include: (1) competing with each other in order to fulfil similar societal functions; (2) complementary relations, e.g. a natural gas regime providing a steady source of supply to the electricity regime; (3) shared structural similarities, as a result of which, separate regimes merge into one; and (4) through spillover effects as a result of the transfer of rules to another (Raven and Verbong, 2007; Raven, 2007). Multiple regimes can also interact via 'functional coupling' such as input-output relationships (Konrad et al., 2008), or 'structural coupling' between infrastructures, for instance, telecommunications using electricity cables (Schot and Kanger, 2018). Konrad et al. (2008) asserted that multiple regime dynamics require consideration because socio-technical transformations often entail overlaps or shared boundaries across regimes such that producers and consumers have closer linkages. For example, Konrad et al. (2008) indicated that from 1920 to the 1990s, closer multiple regime interactions with electricity, gas, water, sanitation and telecommunications developed due to their structural (actors, infrastructures and institutions) similarities. Likewise, Geels (2011), argued that as niches mature, there is a need to interact between two or more regimes, for instance, biofuels link to agriculture and transport, or battery powered vehicles links to transport and electricity.

The research on multiple regime interactions highlights the potential of 'accelerating' niche development through the efforts encouraged by regimes. This then offers an opportunity in understanding transitions as less bottom up and could conceivably be realised through multiple regime interactions. One of the possible means to analyse multiple regime interactions is through the concept of rules, given that it forms a central coordinating and guiding features of regimes (Geels and Schot, 2010). Rules in the form of normative, regulative and cognitive, provide the functional relationship between material resources, actors and organisational networks within the socio-technical regime (Genus and Coles, 2008; Kivimaa and Kern, 2016). This research expects that a focus on rule changes are likely to reveal the types of interactions between regimes. The next section discusses in further detail, the linkages between rules and the regime.

6.3.2 Socio-technical regime and rules

It is well recognised in transitions research that the socio-technical regime is informed by institutional theory, whereby rules are embedded in structures that are both the context and outcome of actions (Geels, 2004a; Geels, 2011). These structures are established through a semi-coherent alignment of normative (values, behavioural norms), cognitive (belief systems, perceptions, search heuristics) and regulatory rules (regulations and standards) (Geels and Schot, 2007). According to Geels (2014a), regime actors could draw on their structures through deliberate strategy, intentionality, and the interpretation of rules. Therefore, the recognition is that regime actors are not 'cultural dopes', but are instead 'knowledgeable agents', that go beyond routine base actions, whereby learning, anticipation and deviating from existing norms are conceived (Geels and Schot, 2010).

More recently, Schot and Kanger (2018) have indicated that rules are exchangeable in a way that variations exist in scope (rules in single or multi-systems) and whether there are single rules or rule-sets in multi-systems. This then allows for the possibility of understanding rules as transferable or negotiable by regime actors, in such a way that it could be redirected or repurposed for new goals. However, there is a lack of research which operationalises the concepts of repurposing rules in regimes, which may provide useful insights into multiple regime interactions. Repurposing rules may also shed some

light in accelerating transitions, as new institutions are not necessarily created but instead redirected towards new goals. It is for these reasons that the current paper sets its aims, in which repurposing rules are tested in South Africa's LNG development.

6.3.3 Rule-changes and institutional theory

Building on the ideas of rules, which are derived from institutional theory, a group of scholars have developed concepts to delineate four different types of rules changes and these refer to drift, layering, conversion and displacement applied in political science research (Mahoney and Thelen, 2010; Streeck and Thelen, 2005). To elaborate: *drift* is when formal rules are deliberately held constant in the face of significant shifts causing their outcomes to change; *layering* when new rules are added alongside old ones; *conversion* is a redirection or repurposing existing rules for new purposes, and *displacement* is the replacement of old rules with entirely new ones. I focus specifically on adapting conversion as it translates into a broader set of repurposed regime rules, which could reveal how shared resources are effectively used.

6.3.4 Conversion: Repurposing existing rules

Conversion defines institutions as 'multipurpose tools' (Hacker, 2015), and refers to the transformation of existing rules through redirection, reinterpretation and re-appropriation depending on which political or economic force is powerful enough to control them in their favour (Streeck and Thelen, 2005; Hacker, 2015). Institutions are therefore subject to mediation and contestation over which functions and purposes they should serve. Moreover, the actors that were responsible for the creation of rules may be different from those who were in charge of shaping and operating them over time. Thus, it is likely that given enough time, the interpretation of rules becomes a variable, as various actors enact them in different ways. According to Hacker (2015), dismantling and creating new institutions is often challenging because there are significant hurdles and barriers in the collective action to do so. Therefore, conversion is a way of sidestepping these efforts by repurposing existing institutions into new

directions or goals. The next section defines the rules, as they are understood in transition research, using these as a basis for the analytical framework.

6.3.5 Defining the rules

For this paper, I follow Geels (Geels, 2014a, p. 267) description of 'industrial regime', which focuses on industry-specific institutions that guide the responses of firms in industries. The 'industrial regime' was used because of the ways in which a regime could respond to specific interests, shared mindsets, cognitive frames and industrial identity and mission (Geels, 2014).

For this paper, the following regime rules are considered, 1) cognitive 2) normative and 3) regulative rules. To elaborate on these rules, a description is further described below.

Cognitive rules refer to industrial mindsets and cognitive frames, which influence interpretations, strategic choices and decisions (Geels, 2014a, p. 267). Strategic responses can include mutual expectations in a way that legitimises choices in specific configurations over others, as well as the inclusion or exclusion of artefacts (Berkhout, 2006). Taken together, responses and choices form shared mind-sets in industries which contribute to cognitive inertia because actors tend to search for solutions within their own sphere of activity.

Normative rules refer to industry identity, values and mission. Here, the normative institutions blind industries towards appropriate behaviour regarding social obligation or pressures to conform (Geels, 2014a). The normative elements signal a societal purpose and expectations which enable legitimacy and validity. An example of normative rules can include values placed on societal problems such as climate change or the phasing out of coal.

Regulative rules refer to regulations, laws and standards, which are imposed on industries through governance mechanisms that facilitate actions in specific directions (Geels, 2014a). Here the basis of legitimacy is through formal rules such as legislation and sanctions.

In the next section, the repurposing of rules according to a conversion lens is operationalised, guiding the analytical research.

6.4 Data and Methodology

In this case study, the analysis is on evolving interaction between the two regimes which led to the development of the LNG for power generation (Gas I4P) and LNG for industrial use, which established the Gas Industrialisation Unit (GIU). The two regimes are South Africa's liquid fuels and electricity. The LNG for power and industrial use is regarded as a niche. The period from 1998 to 2018 was considered, demonstrating how two regimes evolve into a closer relationship. The analytical period started in 1998 because South Africa's White Paper on Energy was implemented at this time, marking significant post-apartheid changes. Significant to this study was the recognition that energy diversification away from coal (e.g. renewable energy, and gas) was needed. I argue that there is evidence to suggest the two regimes grew closer in interaction over time, due to landscape changes, as well as regime tensions. Therefore, the South African case study provides a useful example whereby multiple regimes could be examined using the regime concept of the MLP in combination with institutional changes.

The fieldwork for this research was carried out between June and August 2015, and from March to July 2016. It included 20 semi-structured interviews, 13 of which are drawn upon in this paper, and were conducted in Pretoria, Johannesburg and Cape Town, and the United Kingdom (UK) with representatives from governments, NGOs, the private sector, academia and think tanks (Table 6.1). Moreover, in February 2018, to supplement ongoing updates, a few follow up questions were posed to some interviewees. Furthermore, South Africa's integrated resources plan (IRP), a significant strategic directive from the DOE, was updated in August 2018. The updated IRP had proposed a significant role of Gas I4P in the electricity sector up to 2030. Therefore, the analysis period covers gas developments up to August 2018, and as such, a timely case study. The interview material was then triangulated through a systematic analysis of publicly available documents from South Africa's energy, and the environment portfolio committee hearings, academic publications, and articles in the national press.

Table 6.1: List of interviewees for this research outlining their respective positions

Respondent	Position	Interviews (date and location)
A	Director of oil and gas in a law firm	15 April 2016, Cape Town, South Africa
B	Vice President of South African Petrochemical company	4 May 2016, Johannesburg, South Africa.
C	Chief Advisor of Power System Economics in a State-Owned Entity (SOE)	5 July 2016, Johannesburg, South Africa.
D	Development Manager for an Engineering Procurement, Construction (EPC) and Project Development Firm	15 March 2016, Johannesburg, South Africa
E	Independent consultant that is part of the Gas Industrialisation Unit (GIU) task team	14 April 2016, Cape Town, South Africa
F	A senior manager in an oil and gas alliance organisation	19 April 2016, Cape Town, South Africa
G	Consultant for the independent power producers (IPP) office	10 March 2016, Johannesburg, South Africa
H	Senior academic on energy and infrastructure at a South African university	16 April 2016, Cape Town, South Africa
I	Representative of the IPP office	4 March 2016, Johannesburg, South Africa
J	Representative of the IPP office	30 October 2015, Johannesburg, South Africa

K	Member of Business Unity South Africa (BUSA) energy task team	7 March 2016, Johannesburg, South Africa
L	Senior oil and gas government representative	31 March 2016, Pretoria, South Africa
M	Researcher based in a UK think tank	9 February 2018, U.K.

To operationalise the concepts of conversion, I first grouped the overarching regime rules according to the selection pressures of cognitive, normative and regulative rules (Table 6.2). I then constructed the analytical framework based on the regime rules into conversion by maintaining the definitions of repurposing existing rules. These operationalised concepts of conversion were the type of questions posed to interviewees. For the conversion, examining the displays of repurposing and the redirection of existing rules from the two regimes, which enabled the development of the niche, was necessary. For instance, repurposing existing infrastructure or the redirection of an existing set of skills or technical knowledge such that it caters to the niche, could be considered conversion.

Furthermore, along with cognitive rules, I examined the ways in which the industrial mindsets and strategic choices between regimes are re-interpreted or re-appropriated. Similarly, in the normative rules, it was necessary to look for evidence of redirection in missions and identity to gain social legitimacy or support that could lead to the basis of change in social obligation or appropriation. Lastly, the two regimes could interact due to a repurposing of an existing regulative rule, which favours a niche through legislative means. In my analysis of semi-structured interviews, I did some manual coding to highlight the regular themes outlined.

Table 6.2: Outlining the main regime rules used and relating to the concepts of conversion.

Regime rules	Cognitive	Normative	Regulative
Conversion	Reinterpretation of Industrial mind-sets	New missions' identity, values	Repurpose existing policy instruments or goals

In summary, the analytical framework in this case study uses a combination of the MLP with an institutional lens of conversion (Figure 6.1).

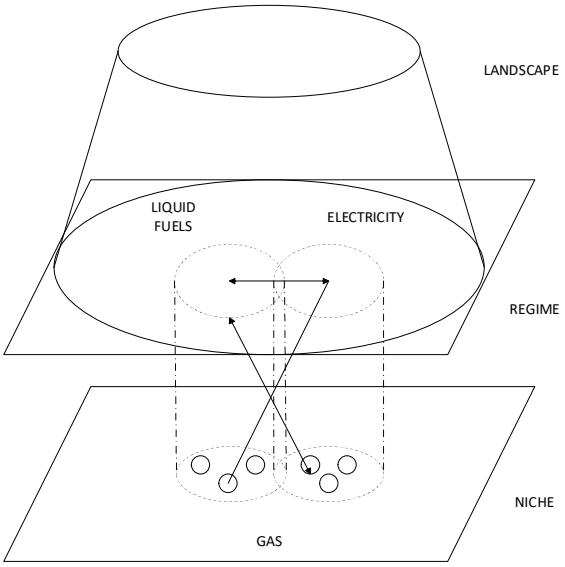


Figure 6.1: Depicting the analytical framework used in this study adapted from Sutherland et al. (2015)

6.5 Multiple regime interactions between liquid fuels and electricity regimes

The analysis of the multi-regime interactions is divided into four periods. The discussion begins by describing the historical background of the two regimes, as a prelude to subsequent events. This was followed by three sub-periods from 1998-2018, where the regimes started with minor interactions. However, due to landscape changes, regime

tensions, and a few processes repurposing existing rules, a closer interaction between multiple regimes emerged, resulting in the development of Gas I4P.

6.5.1 Empirical background of the two regimes

At present, the country's primary energy mix consists of coal (60 %), crude oil (16%), biomass and waste (20%), gas (3 %), and nuclear energy (2 %) (DOE, 2018b).

6.5.2 Liquid fuels regime

South Africa has more than forty years' experience of exploration for oil and gas, but this is somewhat overshadowed considering the dominance of coal. Nevertheless, the country has an existing well-established liquid fuels regime, primarily through a dominant incumbent called Sasol, an energy and petrochemicals company that was state-owned but is now corporatised, and the state-owned national oil company, Petroleum Oil and Gas Corporation of South Africa (PetroSA). Together these two companies use Fischer Tropsch technology to convert gas to liquid fuels (GTL) as well as gas for industrial use. Sasol has an existing natural gas pipeline from Mozambique's Pande and Temane gas fields to South Africa (158 million GJ/year) and a 140 MW gas to power plant used entirely for its purposes (later elaborated in Section 6.5.3). Since the 1980s, Sasol has provided a methane-rich gas (CH_4) as a feedstock to the country's various energy-intensive industries (DOE, 2016, p. 16). In essence, South Africa's existing gas market follows Sasol's historical development. What needs to be appreciated is that in South Africa, Sasol uses gas mostly for its purpose, with an excess supply catering to a peripheral market. Similarly, while Sasol is among the country's largest coal producers, the bulk of this production is to supply its coal-to-liquids (CTL).

PetroSA has extensive oil and gas exploration in the Bredasdorp basin located off Mossel Bay in the Western Cape Province (Figure 6.2) and in 1987 established a GTL plant called Mossgas (Burden, 1992; PASA, 2012). Currently, the Mossgas GTL plant consumes 42 million GJ/year (DOE, 2016). PetroSA provides 5% of the country's liquid fuel needs (DOE, 2015). However, the basin is in decline, and the government has incentives to look for alternative gas supplies to ensure the continued viability of the GTL plant.

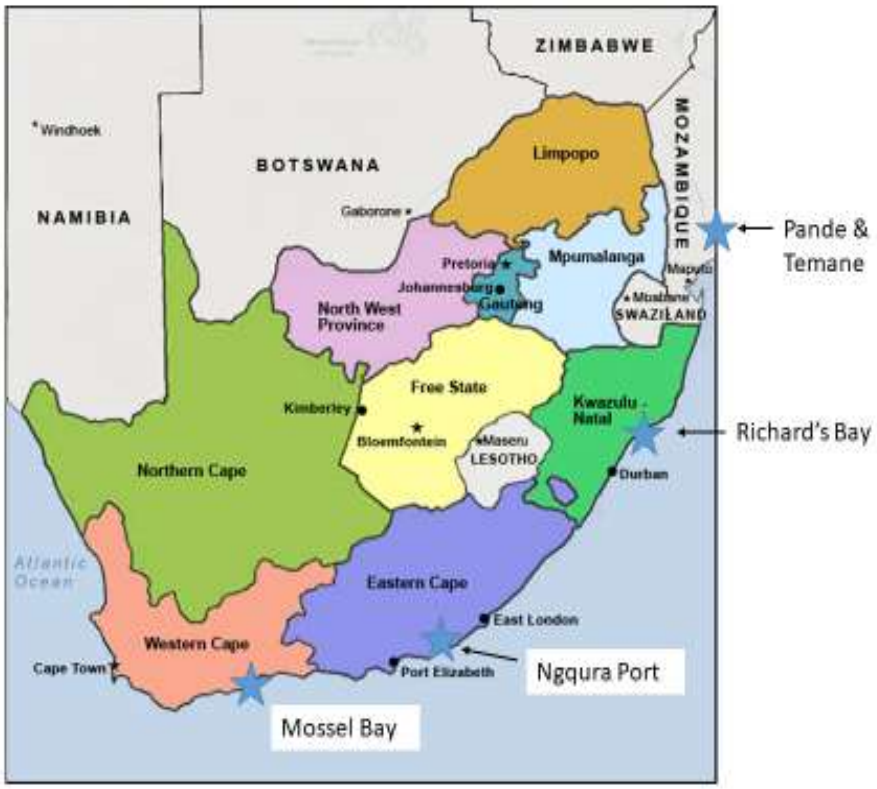


Figure 6.2: Map indicating Mossel Bay, Port Ngqura, Richards Bay in South Africa, with the Pande and Temane gas fields in Mozambique

The main actors in South Africa's liquid fuels regime can be delineated according to upstream and downstream activities (Figure 6.3).

Upstream deals with exploration, which mostly falls under the legislative framework of the Minerals and Petroleum Resources Development Act (MPRDA) that is administered by the Department of Minerals and Resources (DMR). The Department of Energy (DOE) has substantial organisations under its responsibility, with the Central Energy Fund (CEF); a state-owned energy utility that has broad remits to ensure energy security. The CEF controls PetroSA (state-owned GTL refinery), the Strategic Fuel Fund (SSF), iGas (Mozambique to SA gas pipeline shareholder), and PASA (licensing agreements) (Transnet, 2016).

The Gas Act, 2001 administered by the DOE, and regulated under the National Energy Regulator of South Africa (NERSA), covers the **downstream regulatory framework**.

As will be discussed later, Eskom, the state-owned utility for electricity generation, uses diesel for its peak load but has incentives to shift to gas as a cheaper alternative. Regarding gas pipelines, NERSA regulates these through state-owned entities, namely Transnet, as well as ports' infrastructures through the Transnet Ports Authority (TNPA) (Transnet, 2016). For gas to industry, a newly formed Gas Industrialisation Unit (GIU), which deals with gas non-power use, is an initiative by the Department of Trade and Industry (the DTI) which works closely with key players across the sector. In summary, the LNG socio-technical niche has an existing network which is amenable to co-opt for its development. For this research, the gas community which is actively pursuing the LNG is the South African Oil and Gas Alliance (SAOGA), Sasol, DOE and the DTI through the GIU. PetroSA and Transnet are essential but less active (Interview with a senior oil and gas government representative, Respondent L). Thus, it would seem that the key actors are mainly the DOE and the DTI with Sasol and are present in the electricity and liquid fuels regime respectively to achieve a gas economy in the country.

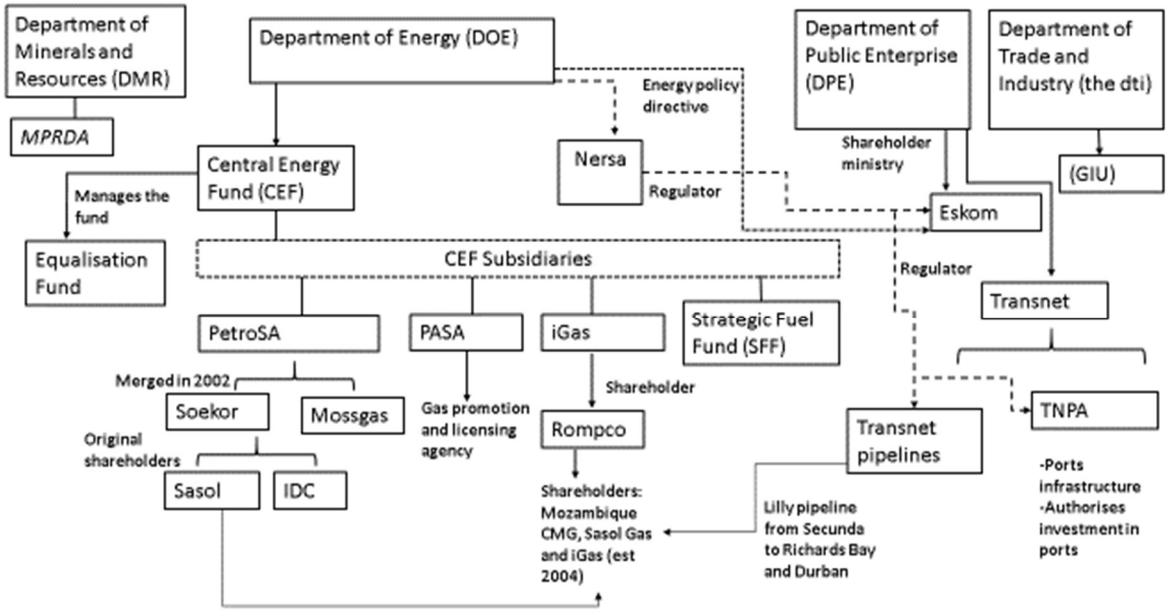


Figure 6.3: The main players of gas activities in South Africa

6.5.3 Electricity regime

South Africa's electricity system was primarily established to support mining and its associated energy-intensive industry in the early 1900s (Fine and Rustomjee, 1996; Ting,

2015). In 1923, South Africa established Eskom, a state-owned utility, which continues to function as a monopoly in 2018. As part of the state-led industrial policy to support the mining sector, it is considered vital for the country's economic development. South Africa's government ensured cheap coal, cheap electricity, government incentives, tax subsidies and import substitution to foster the mining and energy-intensive industries (Makhaya and Roberts, 2013; Roberts and Black, 2009). Consequently, an energy-intensive user group (EIUG), mostly from mining and associated industries, are responsible for approximately 44% of electricity demand in the country (EIUG, 2015). The current state of the electricity sector is that Eskom holds a vertical monopoly responsible for a generation (>90%), transmission (95%) and distribution (>50%) (Eskom, 2015b). Eskom's main consumers are municipalities and industry and mining, accounting for around 80% consumption (Figure 6.4). Eskom has an installed capacity of 37 GW (coal), 1.9 GW (nuclear), 1.4 GW (pumped storage), 0.6 GW (hydro), 2.4 GW (peaking stations with diesel) (Eskom, 2015b).

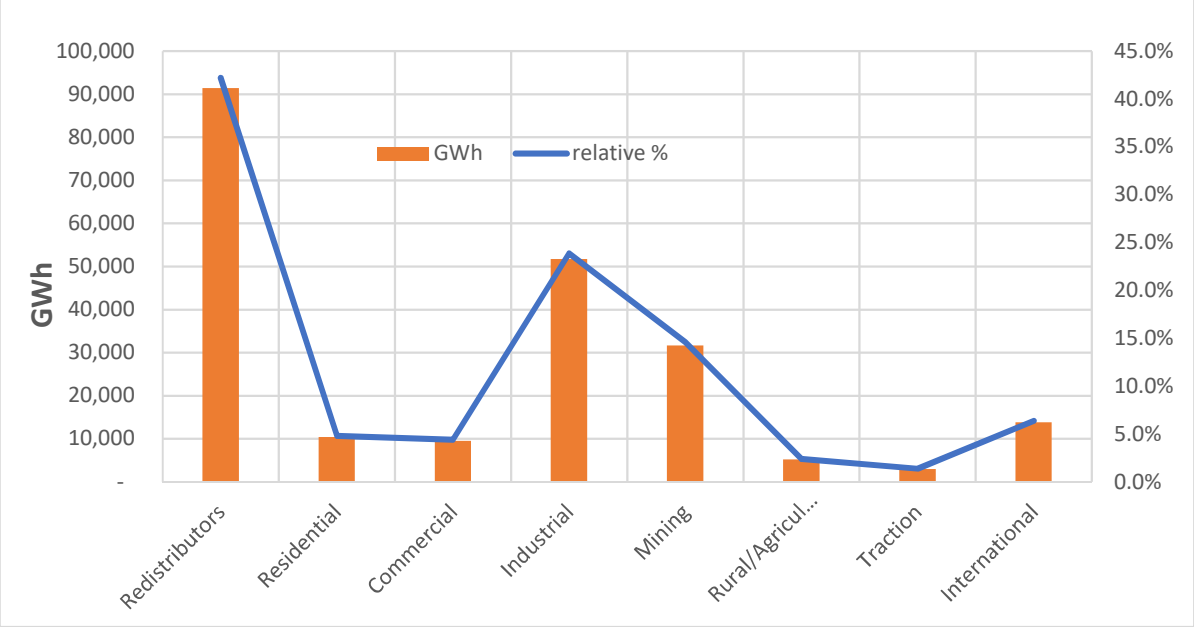


Figure 6.4: Eskom electricity consumption (GWh) relative to consumer use in percentages (NERSA, 2015b)

There are three peaking generation Open Cycle Gas Turbines (OCGT) located in various ports in the country. These existing OCGTs use diesel during peak demand, which is usually considered between 07:00 and 10:00 in the morning and 18:00 and 20:00 in the

evening[41]. The DOE has articulated that more economical use of gas instead of diesel is planned, to support Gas I4P (as elaborated later in Section 6.5.5).

The OCGTs are currently located within an existing, well-established port hub along the country's coastline (Figure 6.2). For instance, in a town called Richards Bay located in the Kwa-Zulu Natal (KZN) province, there are established industries of an aluminium smelter, two titanium smelters, a paper mill and chromium smelter, as well as existing industrial demand for gas due to the Lilly Pipeline (DOE, 2016). In this port, there is a diesel-fired power plant called Avon, of which the DOE plans to convert into gas, with an installed capacity of 670 MW (Figure 6.5).

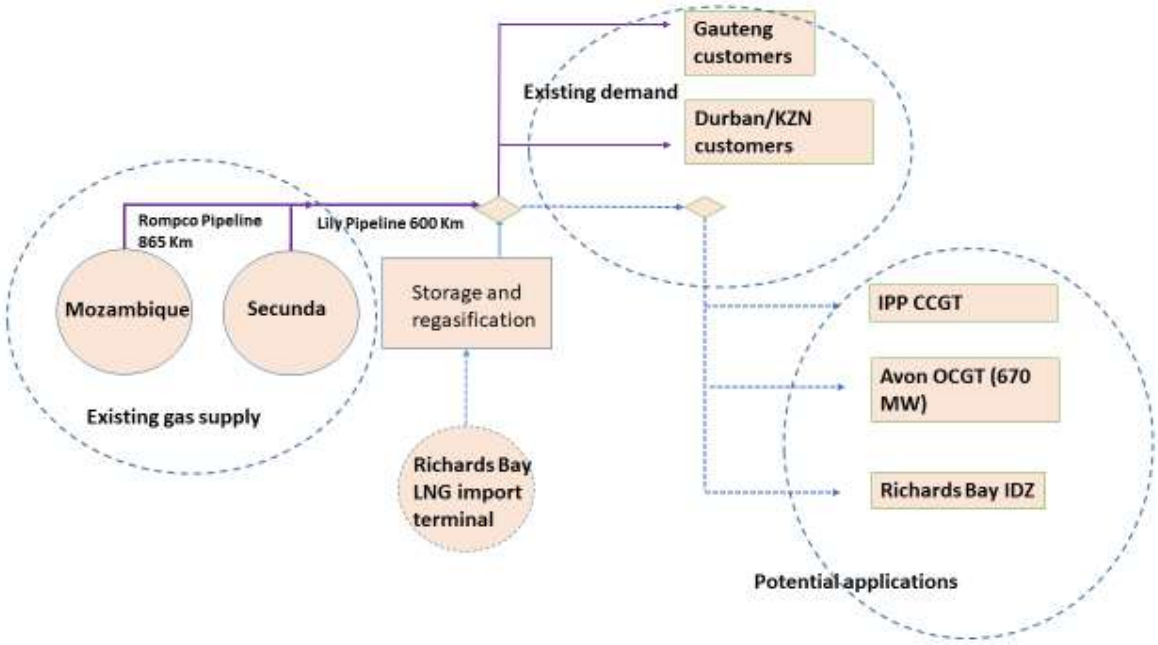


Figure 6.5: Kwa-Zulu Natal's (KZN) potential LNG infrastructure development, adapted from Transnet (2015)

In a nearby port is Ngqura, located in the Eastern Cape Province of the country. It is adjacent to a well-established Coega Industrial Development Zone (IDZ) (Figure 6.6).

[3]Eskom,http://www.eskom.co.za/CustomerCare/TariffsAndCharges/Documents/Eskom%20Booklet.pdf

Coega is also home to considerable investment in renewable energy developments, especially wind farms (DOE, 2016). In this location, there is an operational OCGT plant called Dedisa with a capacity of 335 MW, and a further 350 km away is Gourikwa (746 MW) in Mossel Bay (Figure 6.6). The plans here are to convert Dedisa's peaking plant from diesel to gas firing, and in the longer-term, to establish either a GTL or a minerals' beneficiation plant (DOE, 2016, p. 21).

Together these two ports have been selected by the DOE as the initial steps for Gas I4P. The indication is that implementing Gas I4P could be complemented by existing industrial activities to build a business case in importing the LNG. Essentially, the infrastructure needed for LNG imports has fundamental geographical requirements. Preferably it needs to be close to existing facilities that are amenable to gas and areas where the government could catalyse and sustain industrial activities.

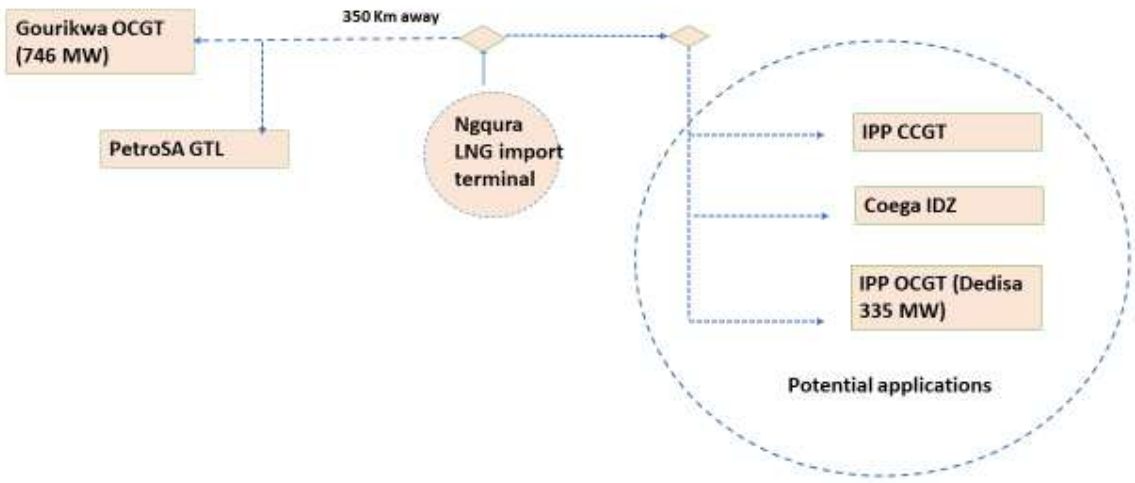


Figure 6.6: Coega potential LNG infrastructure development, adapted from Transnet (2015)

To sum up, South Africa's gas development is planning for electricity generation, industrial use, and export envisioned up to 2040 (DOE, 2016, p. 15). In the short-term, the DOE plans to import LNG to provide an 'anchor demand' for electricity generation as the best way of catalysing the gas economy in the country (DOE, 2016). In the mid to longer-term, the South African government wants to establish a gas market by importing

and stimulating regional trade within the South African Development Community (SADC) and domestic gas utilisation for industrial, commercial, transportation and residential use (DOE, 2016; Transnet, 2015). Ultimately, the longer-term vision is to provide an incentive for upstream players to invest in exploration and production for shale gas in the Karoo region. In this way, South Africa could successfully monetise its indigenous energy reserves, mainly because the resources have similarities to an already existing established extractives based economy (DOE, 2016) (See Appendix E).

In the next section, an emerging closer relationship between the two regimes is discussed, starting from 1998 to 2005.

6.5.4 1998-2005: Energy sector reforms

In this section, the discussion is focussed on the significant reforms in the country's energy sector from 1998 to 2005. These include a landmark policy which signalled the recognition of natural gas as an option to diversify the country's energy mix, the introduction of private sector participation in electricity generation, the establishment of gas pipelines between Mozambique and South Africa, and several institutional changes. During this period, the liquid fuels' regime expanded by establishing key infrastructure developments, while the electricity regime initiated two new coal plants. The two regimes had minor interaction at this point, but this period provided a contextual preamble to gas initiatives that subsequently took place.

In 1998, South Africa's White Paper on Energy provided a milestone policy which signalled significant changes for both the liquid fuels and the electricity regime. In particular, there was the need to introduce independent power production against the country's monopoly system as discussed below, and the recognition of gas due to essential discoveries in neighbouring countries Mozambique and Namibia (DME, 1998). Subsequently, in 2001, the Gas Act was implemented, which established the development of the gas infrastructure in the country through pipelines and the regulatory framework. This Act, as later discussed, has since been amended to adapt to gas developments over time. In 2002, the Mineral Petroleum Resources and Development Act (MPRDA) became operational, which provided remits for oil and gas

exploration and production. At the same time, PetroSA was established consolidating previously separate entities of Soekor and Mossgas.

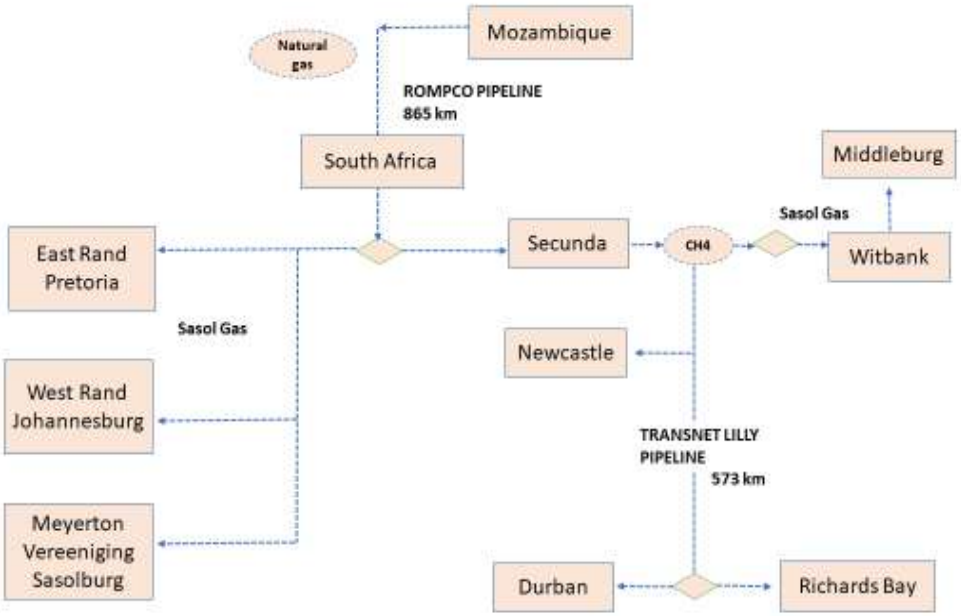


Figure 6.7: Key gas infrastructure in South Africa.[42] (DOE, 2016, p. 19)

In 2004, a gas pipeline between Mozambique and South Africa was established. Sasol, as the dominant incumbent within a liquid fuels' regime, established an 865-km gas pipeline from Temane, Mozambique to Secunda in South Africa (Transnet, 2015). The Republic of Mozambique Pipeline Investments Company (ROMPCO) is mostly owned by Sasol (50%), the Mozambique government (25%) and the South African state-owned Central Energy Fund (CEF) (25%) (Transnet, 2016). However, it has been argued that the Rompco pipeline does not create a real market in the country.[43] This is because the gas pipeline within South Africa (transmission and distribution) is owned and mostly used by Sasol for its plants in Secunda and Sasolburg (Figure 6.7). In 2017, Sasol imported 158 million gigajoules (MGJ) of natural gas, (DOE, 2016, p. 17; Sasol, 2018) used for its

[42] Ch_4 refers to a methane-rich pipeline.
[43] Respondent A

chemical plants and to generate power at an operational capacity of 140 MW (Sasol, 2018). The rest of the gas is routed to the province of KZN, through the Transnet Lilly Pipeline (See Figure 6.7).

While over 90% of the gas transported via the ROMPCO pipeline goes to Sasol, the establishment of the pipeline has, nonetheless, created demand of around 370 industrial and commercial customers via 530 offtake points (DOE, 2016, p. 17). Furthermore, the pipeline has prompted the DOE and the Department of Industry (DTI), to encourage existing industries that use LPG and diesel to switch to natural gas as soon as it becomes feasible to do so. These government departments had started to envision the gas industry in the country.

For the electricity regime in 1998, the Energy White Paper predicted that demand would exceed supply by 2007 (DME, 1998). The DME[44] noted the following:

> "Although growth in electricity demand is only projected to exceed generation capacity around 2007, long capacity-expansion lead times require strategies to be in place in the mid-term, to meet the needs of the growing economy."
>
> (DME, 1998)

What followed from 1998 was a series of significant changes in the electricity regime and including a move towards cost-reflective tariffs, the corporatisation and commercialisation of the utility in 2001 (which started to pay dividends and taxes), a higher cost of capital (due to higher debt levels and weaker credit metrics) and a small potential role for gas for peak load in its Open Cycle Gas Turbines (OCGT) (dti, 2013). As the electricity regime came under pressure to meet the electricity deficit, two new coal plants, namely Medupi and Kusile with a combined capacity of 9.5 GW were commissioned in 2005.

By 2004, the DME ratified the National Energy Regulatory Act which was responsible for the national electricity regulatory framework. (dti, 2013, p. 49).

Despite the 1998 White Paper on Energy Intention for Energy Diversification, coal remained the dominant choice for electricity generation up to 2005. At this stage, the

[44] The Department of Minerals and Energy (DME) split in 2009, forming separate Ministries. From 2009, the Department of Energy (DOE) became the primary energy policy Ministry.

liquid fuels' and electricity regimes had minor links due to Sasol's own use of gas from Mozambique for power generation located in one of its operations at Sasolburg. Therefore, other than these links, the two regimes of interaction could be considered relatively minor. However, given that Sasol has demonstrated the use of gas for liquid fuels' production and power generation, the potential for a closer relationship was evident.

6.5.5 2006-2012- Landscape pressure and regime tensions

During this period from 2006 to 2012, gas started to feature more strongly in South Africa's energy system. A few turning points had occurred; one was the substantial shale gas potential reported by the United States Energy Information Agency (EIA), encouraging policymakers to include gas in the energy mix. Second, there were natural gas discoveries in neighbouring Mozambique and Tanzania, prompting potential regional trade. Thirdly, an electricity crisis in South Africa resulted in blackouts and load-shedding in 2008, pressuring the electricity regime to seek solutions. These three events were significant because both the landscape changes and electricity regime tensions started to escalate.

Consequently, the electricity regime was forced to seek solutions externally to its own coal fleets. In this timeframe, the two regimes started to interact, driven by the need to solve problems derived from regime tension and landscape trends. These are discussed accordingly.

In 2008, South Africa was cited for having one of the top ten technically recoverable shale gas resources in the world, with estimates at 390 trillion cubic feet (tcf) (EIA, 2013). The location for this potential shale gas is in a semi-desert region called the Karoo, spanning approximately two-thirds of the country. (EIA, 2013). Although shale gas development has a long way to go, the report by the EIA catalysed significant interest, particularly with the government, often articulating it as a game changer (DOE, 2016b, p. 24). From 2008, onwards gas started to feature more strongly, and this was reflected in the DOE integrated resources plan in 2011.

Around the same time, from 2009 onwards, regional discoveries of gas near South Africa were raising interest amongst the national gas community. The most promising natural

gas discoveries were discovered off the coast of Mozambique and Tanzania. The area called the Rovuma basin in Mozambique garnered enormous interest in the Southern African gas community region (Ledesma, 2013; Symons, 2016). The Rovuma basin has potential natural gas reserves estimated at 100 tcf, with two main areas for exploration operated by the US-based Anadarko and the Italian company, ENI (Ledesma, 2013). The Rovuma basin is a significant gas play, dwarfing regional gas discoveries elsewhere including Namibia, Tanzania and Angola.[45]

Anadarko is planning to build two 5 MTPA (million tonnes per annum) liquefaction trains with an expected operational date by 2021 (DEDT, 2013, p. 34). As later described, neighbouring countries gas discoveries are part of the South African government's means to initiate a regional industrial trade.

By 2012, major national stakeholders in the South African gas industry were established, and these included the Southern African Qualification and Certification Committee for Gas, South African Oil and Gas Alliance (SAOGA) and Gas User Group (GUG), which represents 13 large domestic manufacturers (Ethekwini, 2015, p. 105). Based on a growing number of gas associated stakeholders, there is an indication that an expansion of the gas community could contribute to shaping the ideas, opinions and practicalities needed to achieve a gas economy in the country.

For the electricity regime, in 2008, a major electricity crisis occurred through blackouts and load shedding (Ting and Byrne, 2020). The electricity regime tension had a destabilising effect, which prompted a search for solutions to the problem. During the electricity crisis, Eskom used (amongst other measures) costly diesel OCGTs to mitigate the shortfall in supply (Figure 6.8). Eskom reportedly operated the OCGT's at a load factor from 0.3% in 2009/10 to 19% in 2013/14, instead of a typical peak load of up to 5% (Eskom, 2015b). Subsequently, Eskom spent substantial operating costs to mitigate the electricity deficit (DEDT, 2013). A study indicated that, at a load factor of 20%, running a peaker gas-fired Closed Cycle Gas Turbine (CCGT) on imported LNG had less impact on the country's trade balance than running the same CCGT on diesel (DEDT, 2013, p. 50). The study also showed that the higher the load factor of a peaker plant,

[45] For comparison, technical gas reserves in Angola are around ten tcf, Namibia less than one tcf and South Africa's offshore basin is less than one tcf.

the stronger the imperative to replace diesel with LNG. Therefore, there is potential in mitigating the trade deficit associated with imported diesel, by using gas as an alternative feedstock.

Using diesel during the time of crisis, it became apparent to the DOE that this measure was a costly solution. At this point, gas for power generation became an option because of the electricity crisis and the potential regional natural and domestic shale gas. As often articulated during interviews, gas provided benefits over diesel such as affordability and the probable use between electricity and industry.[46]

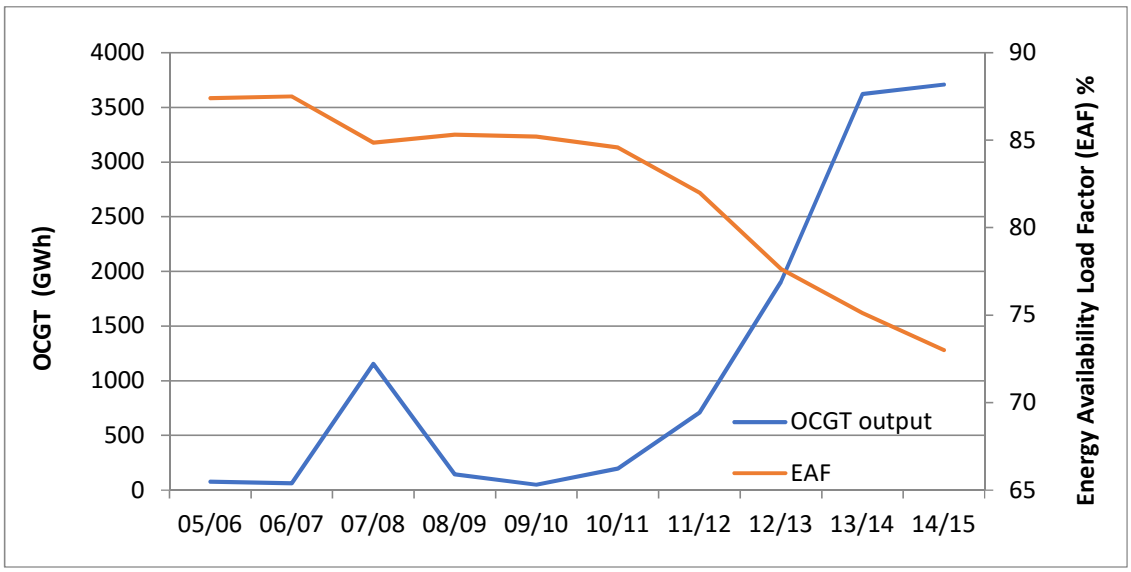


Figure 6.8: Eskom's use of diesel relative to its Energy Availability Factor (EAF) [47] (Eskom, 2015b)

Eventually, in 2011, as a response to the electricity crisis, the DOE ratified legislation called the New Generation Capacity, under the Electricity Regulation Act (DOE, 2018b). The New Generation Capacity introduced the Renewable Energy Independent Power Producers Procurement Programme (RE I4P). This provided a much-needed private sector investment into the country's electricity generation. Despite significant delays and challenges to its implementation, the RE I4P was, in the first instance, very successful, as a result of which the DOE decided to adapt the model in order to procure

[46] Respondent A, C, H.

[47] EAF measures plant availability, plus energy losses not under the control of plant management (external).

gas and coal from IPPs. From here, the policy instrument of introducing independent power producers became an essential policy tool for Gas I4P.

6.5.6 2013-2018 Emergence of multiple-regime interactions

From 2013 to 2018, gas development started to gain momentum driven by significant landscape trends that included increasing sophistication in LNG liquefaction, favourable gas prices that were conducive for imports, and changes in LNG trade patterns favouring countries that wanted to import LNG. Moreover, in this period significant conversion changes were evident, particularly the repurposing of the RE I4P policy instrument used initially for renewable energy, later used for Gas I4P.

Furthermore, the plans for potential gas trade with Mozambique became formalised through the DTI critical industrial policy action plan (IPAP). Lastly, technological development of the gas niche became more specific, mainly outlining procurement under a bundled case, with a floating storage re-gasification gas unit (FSRUs) as the preferred model (DOE, 2016, p. 23). Gas I4P was often articulated to provide flexibility to the electricity grid, a suitable load follower to renewable energy intermittency and provided less risk of stranded assets. Overall, the development of gas to power started to stabilise, resulting in liquid fuels' and electricity regimes to interact much closer compared to previous periods.

In this period, at the landscape level, three significant trends regarding LNG technologies raised interest in the gas community. These were the increasing trends towards the liquefaction of gas and bypassing the need for pipelines. For a long time, gas was unable to match the strength of the oil trade through marine transportation (Kumar et al., 2011, p. 4098). However, the relative advancement in liquefaction technology has enabled the possibilities to commoditise gas that bypasses sunk investments such as pipelines. Moreover, gas distribution through pipelines suffers from what is called maximum site-specificity (Dorigoni et al., 2010). The higher the switching costs for alternative use of a fixed asset, the higher the degree of specificity. This makes pipelines an inflexible asset, with a high emphasis on ties between buyer and producer (Dorigoni et al., 2010). In this regard, there is an expected growth of 46% in global liquefaction capacity by 2021, and

these are mostly attributed to the United States (US) and Australia, as well as Russia, Malaysia, Indonesia and Cameroon (IGU, 2016, p. 17).

Secondly, gas prices are changing from long-term to short-term contracts which opens up to a competitive, spot market and attracts new buyers to the sector. It was reported that short-term (less than five years) LNG trade grew from 8% in 2005 to 29% in 2015 (IGU, 2016, p. 13). A South African study has shown that importing LNG at a gas price of $7 per MMBTU or less can compete with coal (Eberhard, 2015). Given the changing dynamics of global gas prices, it was articulated during interviews that South Africa could negotiate at this favourable price, depending on aggregated demand. [48]

According to one interviewee who represents government and industry:

> past gas volumes were based on oil indexations, but there are structural changes with producers. It is a good time [for SA] to be a buyer because there is a chance to capture good terms in the contract. Time frames are flexible; we are now looking at 5-year contracts. Because of these short-term contracts, countries planning to import LNG are in a better position to negotiate gas prices at favourable rates.
>
> Respondent A

From these sentiments, the implications for short-term trade and lower gas prices mean that the South African gas community believes they are in an excellent position to negotiate favourable contracts.

Thirdly, there are changes in LNG trade patterns, which means new market dynamics between traditional exporters and importers. According to the IGU (2014), "the emergence of new areas with tremendous [LNG] supply potential has been one of the most striking changes in the LNG industry in the last three years."

Overall, the impact of these factors means a re-direction of LNG volumes to markets without an established liquid gas trade (IGU, 2016, p. 14). Interviews with a representative from the private sector and government articulate that due to global changes in LNG trade, mainly in the shift of traditional exporters and importers, oversupply in the short term, and advances in liquefaction capacities, SA could take

[48] Respondent A, D, E, L

advantage of these changes.[49] The three trends were consistently iterated during interviews and used to justify gas developments in the country.

By 2015, due to the success of the renewable energy programme, the DOE repurposed the IPP policy instrument in what can be described as conversion, to procure various other technologies including coal, gas and cogeneration. As one interviewee noted:

> The idea is that the IPP will handle the bidding process and try to replicate the renewable energy process and success.
>
> Respondent F

Thus, by 2015, the DOE announced Gas I4P with the procurement of 3.7 GW electricity generation (DOE, 2016). Gas I4P was effectively formalised into the electricity sector, given the strong signal that the policy instrument had provided. According to the interviewees, before 2013, scaling gas into a nationwide market stalled in the past, primarily due to lack of (1) sufficient infrastructure, (2) industrial demand, (3) indigenous gas reserves, (4) clarity in government policies, and competing for the dominance of liquid fuels and coal.[50]

Moreover, one of the potential concerns for importing LNG is the case of dollar-based indexation of LNG prices. This could be problematic because imported LNG is priced in US dollars, but revenues from a power purchase agreement are likely to be in domestic currency. This will have a direct impact on electricity tariffs, bearing in mind that South Africa is already facing huge public resistance to electricity increases and its domestic currency is weakening against the US dollar.

Nevertheless, gas has been in the background in the overall energy sector. Furthermore, with Gas I4P, the DOE made clear indications that development would be close to an existing diesel-based electricity generation, as well as existing industrial development zones. Likewise, during this period, the electricity regime had persistent problems, as the new coal plants were not commissioned in time, blackouts were continuous, and electricity tariffs increased (Ting and Byrne, 2020). Consequently, the electricity regime

[49] Respondent A, F, J
[50] Respondent A, D, E, F, G, I, J, M

grew with tensions over time and increasingly became a visible focal point for public discontent over their rights to civic services and delivery.

As was earlier outlined in Section 6.5.3, two sites selected for Gas I4P were the Port of Ngqura (Eastern Cape Province) and Richards Bay (KZN). Both locations have gone through significant environmental impact assessments and techno-economic feasibility studies to determine the best LNG terminals (DOE, 2016). Thus, there is an indication that Gas I4P is taking advantage alongside an existing infrastructure development. Both Ports of Ngqura and Richards Bay have dedicated special economic zones with incentives from the local government to stimulate industrial development. In this way, the plans by the DOE to repurpose the diesel base OCGT for gas use, as well as stimulating industrial demand, was already in place.

The plans for Gas I4P implementation and the site selection made the technological requirement more specific, particularly as questions were being asked about the type of LNG plant to be established, provincial support, funding models, meteorological conditions and port configuration needed (Transnet, 2016). Likewise, there was a precise alignment that renewable energy and gas are complementary and compatible power generation sources.[51] Related to this, an interviewee from the electricity regime stated that gas is the best option as a load follower to renewable energy intermittency, as it can be ramped up or down as needed.[52] Thus, there is an increasing awareness that to meet uncertain electricity demand, a modular, flexible generation and fewer chances of stranded assets are needed of which gas provides such an option. [53]

These sentiments seem to indicate that technical specification and choices were becoming explicit, with a more precise direction for the implementation of Gas I4P. Consequently, the DOE planned to convert existing OCGTs into dual fuel services that will enable it to use diesel and gas. This suggests that the DOE has started to re-purpose at least part of Eskom's fleet and the system requirements which could favour Gas I4P.

As Gas I4P gained traction, the implementation of gas widened as a potential feedstock for the industrial process, commercial and residential cooking and heating applications

[51] Respondent A, C, F, K.
[52] Respondent C
[53] Respondent H, L

(DOE, 2016, p. 15). The typical alignment of expectations considering gas development is that it provides socio-economic benefits and can contribute to lowering greenhouse gas (GHG) emissions (Eberhard, 2015). Here, aspects of normative elements are evident given that Gas I4P is embedded in the national development plans (electricity and industrialisation) which is argued to form a part of the increasing social awareness and expectations that in turn could ultimately lead to legitimacy.

Moreover, related to cultural-cognitive elements, a prominent interviewee in the liquid fuels' regime articulated and noted the following:

> gas, in essence, covers two things, commodity and energy security
>
> Respondent B

From this sentiment, an indication is that shared industrial mindsets have started to widen as ideas and interpretations for gas applications were considered both in electricity and liquid fuels (DTI, 2018, p. 169). In a way, there was a belief that gas had a role in the electricity sector as well as in industries.

There are two opportunities from importing LNG into the country that could benefit from the development of the industrial sector. First, are the costs saved by switching fuel away from diesel, liquefied petroleum gas (LPG), and heavy fuel oil (HFO), which are deemed more expensive than LNG imported at $10/MMbtu (Deloitte, 2015). The second opportunity is to use gas for ammonia processing to produce fertilisers, as well as methanol production, and direct reduced iron (DRI) (an alternative source to produce steel) (DMR, 2005; Steenkamp and du Preez, 2015).

Both of these opportunities have spurred ideas for using gas beyond electricity generation. This was evident with the country's annual Industrial Action Plan (IPAP) – an essential national industrial strategy document – mentioning the importance of gas, followed by the establishment in 2017 of a Gas Industrialisation Unit (GIU) within the dti.

The GIU includes members from Sasol, various government departments and others. These are indications that existing normative elements between electricity and liquid fuels' regimes have grown in interaction.

According to Garth Strachan, the Deputy Director-General on Industrial Development at the DTI stated that[54]:

> The vision of the GIU is to build on the momentum of gas to power development, using gas for scale-up-and downstream industrialisation, and as one of the pathways to regional industrialisation

Thus, beyond national plans for gas were intentions for intra-trade between the Southern African Development Community (SADC), particularly with the proximity of Mozambique (DTI, 2018, p. 168).

> "We are proposing the establishment of an Inter-State Natural Gas Committee to share learning for regional gas development and to prepare for the development of the wider gas economy."
>
> (2017).

Additionally, the DTI has identified industries that could align with gas developments. These are iron and steel, mining and quarrying, petrochemicals, non-ferrous metals, non-metallic minerals, cement industry, power generation, fertilisers and GTL (Mavuso, 2015). Thus, the South African strategic imperative is to re-direct 'close at hand' capabilities into using gas as a long-term objective (Mavuso, 2015). Close at hand implies that existing capabilities such as those found in liquid fuels and associated industries could benefit from the expansion of economic activities using gas. The strategy is to stimulate the multiplier effects of linkages in the gas value chain to build sufficient gas industrialisation.

As indicated in most interviews, the re-industrialisation of the country's economy could be achieved through the initial catalytic start with Gas I4P and later with industries. The belief is that gas could be the country's next commodity resource, as the country's mining future was uncertain and is on a decline. [55] Related to this, some actors in the oil and gas community are pushing for a pivot of mining skills towards the upstream gas sector as potential new ventures for the extractives industries. [56] The indications were that the skills required for drilling and exploring gas fields are deemed similar to those

[54] DTI launches Gas Industrialisation Unit, https://www.engineeringnews.co.za/article/dti-launches-gas-industrialisation-unit-2016-05-16
[55] Respondent A
[56] Respondent F

found in mining. These views are considered as examples of re-interpretation for the industrial mind-sets as there is an interrogation of the continued relevance of mining in the extractives industry given the massive potential of shale gas in the country.

By August 2018, gas was articulated by the latest country's integrated resources plan, to play a significant role in the future electricity generation. The indications were that gas would contribute as much as 15% of the installed capacity mix by 2030 (DOE, 2018a). This seems to suggest, at least to some degree to the energy policymakers, that gas to power has the necessary fit, form and compatibility with the electricity system. Thus, with the considerable future role of gas in the electricity regime, and the inclusion of gas in the country's industrial plans, these are instances of new missions and beliefs, and would, therefore, illustrate a broader institutional change of conversion.

6.6 Discussion

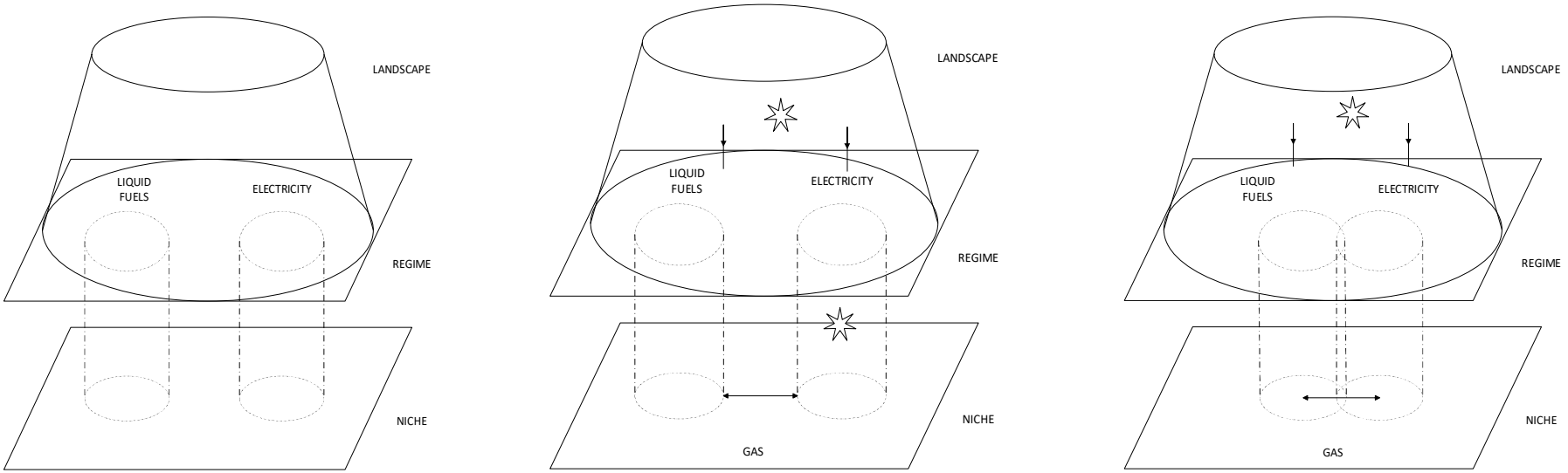
Using a conversion lens, this case study revealed the co-evolutionary nature of multiple regime interactions, through repurposing existing institutions over time. Moreover, it was demonstrated that repurposing existing rules between the regimes was in response to cumulative landscape pressures and electricity regime tension over time. This section discusses the main findings, which integrates each of the three periods outlined, followed by suggested contributions to empirical and theoretical research (Figure 6.9). Reflecting on the case study, the two regimes of electricity and liquid fuels grew in interaction through the repurposing of the cognitive, normative and regulative rules. The interaction between the two regimes was preceded by changes at the landscape and regime level. Thus, the period from 1998 to 2012, provided a preamble as to why the regime interaction had occurred later. From 2012 onwards, the emergence of regime interactions featured more strongly.

For instance, in 2004, Sasol, the dominant incumbent in the liquid fuels regime, implemented a pipeline to import gas from Mozambique, catalysing a significant change in its operations, using gas as a feedstock for the GTL process and electricity generation. Although Sasol used the imported gas mostly for its own purposes, nevertheless the demonstration of the large-scale project encouraged and planted ideas for the potential feasibility of a gas economy in the country, at least amongst the actors involved in both

regimes. Around the same time, the electricity regime endured a series of changes, leading up to the commissioning of two new coal plants. Viewed from an MLP perspective, in the first period analysed, from 1998 to 2005, no significant landscape changes were observed, and both regimes had expanded. Therefore, without any evidence of 'cracks' or a window of opportunity at the landscape or regime level, at this stage, the two regimes had minor interactions.

In the second period (2006-2012), the first signs of changes started to appear with potential shale gas in the Karoo region, further gas discoveries in Mozambique and a significant electricity crisis. Also, in this period, there was evidence of an increasing number of gas-related stakeholders in the form of industrial alliances, users' group, and associated policymakers. This community would provide a critical point of reference whereby ideas, perceptions and interests were deliberated and served as feedback loops. Overall, these developments prompted the search heuristics of the electricity regime to widen. At first, the solution was the introduction of a policy instrument that enabled the development of renewable energy in the country (Ting, 2019; Sovacool et al., 2018a). This could be described as a 'local search,' as the adjustment was incremental, and it maintained the structure of the regime (Geels, 2014a). However, with sustained pressure on the electricity regime, together with prior elements of infrastructure development by Sasol in the liquid fuels' regime, conditions for gas development were apparent. In time, the constant blackouts by Eskom are what could be considered as a structural performance problem (Geels, 2014a). This meant the electricity regime actors were prompted to question the foundational elements of the regime, and this, in turn, stimulated actions beyond structural constraints. Here, the electricity regime had eventually engaged in a 'distant search' (Geels, 2014a, p. 271) because options for radical alternatives and new knowledge bases were explored. Given the need to seek meaningful solutions, by the third period (2013-2018), a closer interaction between the two regimes became evident.

Figure 6.9: Regime interactions and niche development from 1998-2005 (adapted from Sutherland et al. (2015)



1998-2005

Minor interaction between the two regimes

Key developments

Liquid fuels' regime expanded in 2004. A gas pipeline was established between Mozambique and South Africa.

Electricity regime expanded with two new coal plants.

2006-2012

Minor interaction between the regimes

Key developments

Landscape pressures due to regional gas discoveries and a major shale gas potential was reported.

Electricity regime tension due to major crisis in 2008

*The asterisk explains the landscape pressure and the tension with the regime.

2013-2018

Emerging closer interaction between the regimes

Key developments

Major landscape trends of increasing liquefaction sophistication, changes in global gas prices, and LNG trade patterns

In 2015, Gas I4P was initiated by DOE, and in 2016, the Gas Industrial Unit (GIU) was established by the DTI

Significant niche development.

By 2015, the policy instrument for IPP that initially catered to RE I4P was repurposed to procure other technologies, including gas. In time to implement Gas I4P, the level of activities in technological choices became specific and robust, as was demonstrated by decisions in the type of LNG to be imported, the selection of port sites, and the conversion of existing OCGT plants to dual services, as well the indication that gas would provide flexibility as a load follower to renewables. Therefore, as cognitive elements such as technical knowledge, operational processes, and funding mechanisms increasingly matured, so did the involvement of a community of a variety of actors. These included national and local governments, societal groups, finance, industry stakeholders, environment, infrastructure requirements and the research community.

This suggests that an infrastructure intensive project such as the LNG for power and industrial use, required the interaction of a broad base of actors, and these were found in both regimes. Moreover, the complementary characteristics between coal-fired electricity and the liquid regime enabled the corresponding shared mindset with similar networks and interests mainly related to the extractives industry.

Related to this, the technological specificity of the LNG was amenable to modular and flexible implementation, provided fewer risks of stranded assets, which are likely to contribute to more accessible linkages between regimes, and portability amongst applications. There was also an indication that the LNG for power could offset the intermittency of renewables in the electricity grid and provide prospects to develop a gas industry. Thus, another critical aspect that enabled interaction was the perceived opportunities for both regimes. For instance, Gas I4P was reliant on LNG importation, the selection of ports meant that the associated local government with the nearby special economic zones had incentives to pursue the initiative. The ports that were selected had existing diesel OCGT plants which were amenable to be repurposed into dual fuel services. Significantly, the proximity of existing established industries stimulated the national and local government to catalyse a gas value chain. This was demonstrated by the inclusion of gas in the national industrial plans governed by the DTI, which resulted in the establishment of a dedicated GIU.

The GIU established a task force, including Sasol, various government departments and other gas stakeholders. The perceived opportunities for gas industrialisation in conjunction with energy security resulted in shared interests amongst actors in both regimes and thus facilitated ongoing interaction. The gas industrialisation industry also motivated interests in regional trade with Mozambique, which is increasingly in line with an overarching industrialisation strategy with SADC. This means that the plans for achieving a gas economy in South Africa suggest an extensive development from a national, local and regional scale. As such, the outreach was broad with prospects for interfacing with a diverse community. Moreover, the opportunities provided by a gas economy prompted support from the government and the private sector, particularly from the extractives industry, and would thus, likely be responsive to repurposing or complementing shared resources.

Furthermore, as there was a gradual expansion of shared industrial mindsets, maturity in technical knowledge, and societal expectations for the development of the LNG niche over time, these changes, in turn, gave credibility and legitimacy in support of the LNG niche, which led to the alignment of interests and formation of actor-networks between the two regimes. What followed was that some actors started to articulate a change in beliefs in the extractive industries whereby the country should be exploiting gas as the new commodity due in part to the precarious condition of the mining industry. For instance, there was a suggestion that the established mining skills in the country could be re-directed towards exploring shale gas fields as those found in the Karoo region.

Thus, together with changes in the industrial mindsets at least in the extractives industry, and the inclusion of gas in the country's national development plans, this suggests that gas is increasingly embedded within normative goals in both regimes. Changes in core-beliefs, mission and identity, are considered deeper forms of institutional change (Geels, 2014a). This means that the emergence of linkages between the two regimes could possibly lead to enduring connections and greater configurational transformation (scope and depth) over time.

Lastly, the multiple regime interaction observed in this case study has implications for policies with the intention for sustainability transitions. It would seem that the prevailing actors in both regimes are centred on extractive base industries. Thus, the hopeful change for sustainability transitions, through the renewable IPP policy instrument, was vulnerable to co-option by powerful actors that already subsists within the system, and in this case, seems to strengthen the fossil fuel-based system. Therefore, the underlying institutional settings in both regimes predicated on extractives based industries were likely to favour repurposing rules in order to pursue each other's interests. In line with Hacker (2015), who emphasised that rules are subject to re-interpretation depending on groups that may have the necessary resources to re-direct them according to their benefit. In this way, the policy intent needs to pay attention to dominant groups that can navigate the direction under which transitions can unfold.

In conclusion, a close interaction between the electricity and liquid fuels regime was necessary for nurturing the LNG niche. After sustained structural performance problem experienced by electricity regime, it was later forced to seek a 'distant search' for solutions. Given that South Africa's has a well-established liquid fuels regime, with experience and infrastructure for importing gas from Mozambique and with Sasol a world leader in converting gas to liquid fuels, the prospect of LNG for power became an option.

6.7 Conclusion

The current MLP literature suggests that windows of opportunity either from the landscape or regime level provide spaces for niches to develop, eventually resulting in overthrow or displacement of a regime. However, this regular pattern of scale-up from a niche to a regime could likewise develop through the support of multiple regime interactions. The literature on multiple regimes suggests that the process can be illustrated as complementary, symbiotic, or even competitive. These theoretical concepts, while helpful in some context, are limited and require a better explanation of why and how regimes interact over time. The evidence found in this research potentially reflects the limitations of engaging with the concepts of niche, regime and landscape in isolation, showing that at any point in time, multiple layers of interactions are at play.

There is, therefore, an interconnected co-evolutionary process that was enabled through repurposing existing institutions. The case study shows that multiple regime interactions can be characterised as repurposing existing rules as part of the efforts to drive innovation at a niche level.

Through a conversion lens, the regime interactions had enabled the repurposing of existing cognitive, normative and regulative rules. However, it is not evident in the literature what the enabling conditions were for conversion to proceed. The empirical case demonstrated that repurposing rules were not automatic nor spontaneous, but instead cultivated over time, due to shared similar interests and perceived opportunities derived from the LNG niche. Moreover, a growing shared community provided a reference for reflecting on ideas, concepts and feedback loops, enabled the linkages between the two regimes. These, in turn, led to a supportive environment both from government and from the private sector, particularly the well-resourced extractives industry. Lastly, an increasing alignment towards normative goals in both regimes has provided a supportive setting for sustained interaction.

Finally, the current study is cognisant that the findings are drawn from a single case. However, the aim was to contribute to transitions literature on multiple regime interactions and thus open up for comparative research between similar types of infrastructure intensive initiatives. Moreover, transitions researchers need to pay attention to the potential of shared boundaries and similarities between various regimes, such that multiple regimes are increasingly recognised and analysed.

CHAPTER 7

DISCUSSION AND CONCLUSION

7.1 Introduction to the chapter

The purpose of this chapter is to synthesise the principal findings of the thesis and outline its contributions. I begin by the outlining the motivation of the research, the main findings, and how these relate to the extant literature. Subsequently, the research questions are revisited, outlining the findings of each paper, followed by the overall relevance to the overall thesis. Issues discussed include incumbent obduracy, regime resistance, the duality of the regime relative to structure and agency, and the dynamism of regime and niche actions that emerged in the case studies in relation to various institutional changes. Finally, the chapter ends with a discussion of the limitations and recommendations for future research.

7.1.1 Motivation and main findings

In the South African case study, the motivation was to understand the processes by which incumbent actors embedded in the MEC, with Eskom as a dominant regime incumbent, and how they responded to the introduction of renewables and gas for power. The electricity regime was characterised as resistant to changes due to entrenched, vested interests derived from actors embedded within the MEC. Therefore, there was an opportunity to generate empirical insights and understand how sustainability transitions are being achieved in the South African context. In doing so, the findings aimed to contribute to the ST literature on regime stability and change and finding ways in which processes and mechanisms can realise accelerated sustainability transitions.

I built on the notion of the regime as a highly institutionalised structure, which describes regime stability as levels of structuration and degrees of institutionalisation

(Fuenfschilling, 2014). This thesis mobilised concepts related to institutional theory and the MLP, revealing nuances in the relationship between structure and agency or what is generally called the dual nature of the regime. I argued that a punctuated equilibrium approach to understanding regime change underestimates the value of analysing internal regime responses to shifting core rules as they play out during a transition. Instead, I used the four modes of endogenous institutional change (drift, layering, conversion and displacement) because they helped focus the analysis on changes in rules, which are the main stabilising features of the regime, and internal regime responses.

The research findings show the South African electricity regime evolving from high to low stability into what is now a fractured regime with features of partial displacement (Table 7.1). In the early stage of the case study period, the electricity regime had a highly institutionalised structure. Through the drift mode of endogenous institutional change, the case study showed that the regime tried to *maintain* stability in the face of pressures from the recently introduced renewables and gas niches. We observed that given the structure of the regime in this early stage remained intact, the maintenance of rules was feasible because of the resources amenable to the dominant regime incumbent. However, as the existing rules became less coherent, and the regime resources were in decline, regime stability slipped from high to limited, and its structure became moderate. Then, through the layering mode of change, another regime actor, the DOE, was forced to *reform* existing institutions in order to repair the crisis in the electricity regime leading to the development of the renewable energy niche. Here, layering was useful in delineating a co-existence between the niche alongside the dominant incumbent. Following other changes, regime stability slipped from limited to low, and the regime structure became weak. In response, regime actors (electricity and liquid fuels) supported the LNG niche by *reinterpreting* existing rules. Through this conversion mode of change, the case study showed that repurposing existing institutions was possible because the weak regime structure provided space for electricity regime actors to interpret the set of existing rules and resources differently.

The cumulative effect of the above changes suggests there are now features of early displacement of the regime: it became fractured as its core rules became increasingly

untenable. In this regard, a weakened regime structure has led to features of *defection* from the core rules because regime stability is low and open to a variety of unpredictable changes. All things considered, using a combination of modes of endogenous institutional change with a more nuanced concept of regime structuration enabled the examination of the dual nature of the regime more fully, which in turn demonstrated the dynamism of regime stability and change. We saw that as the regime structure changed different kinds of regime responses emerged. Using endogenous institutional change, therefore, proved valuable because it helped to explain the kinds of agency expressed in relation to structural change.

Table 7.1 A summary of the main findings of the research in relation to regime stability and institutional changes.

Structure	**Agency**	**Stability of the regime**	**Institutional status**
Strong	Maintenance	High	Institutional reproduction (Chapter 4)
Moderate	Reform	Limited	Co-existence of a niche alongside a dominant incumbent (Chapter 5)
	Reinterpretation		Repurposed existing institutions (Chapter 6)
Weak	Defection	Low	Early features of partial displacement (Chapter 7)

In sum, this thesis has provided a more nuanced understanding of the regime as a less passive, rigid and monolithic bloc or a single regime transformation, instead of being dynamic and actively resourceful. These perspectives of regime transformation are part of engaging the ontological assumptions of the MLP as they have played out in the South African context. The implications this has regarding ST literature is that more research is needed, which attends to niche strategies that evolve according to regime stability. Thus, instead of assuming the regime to be a monolithic bloc, niches could use different processes such as learning, expectations, actor–network formation and experimentation against various stages of regime stability (high, limited and low).

Moreover, destabilising the regime should be aligned to nurturing niches, such that the directions of both decline and rise, respectively, are explored for a systemic change. Therefore, this research contributes to the broader literature on directionality (Stirling, 2008) and transformative innovation (Schot and Steinmueller, 2018), which are research agendas that aim for new ways of thinking that radically transforms socio-technical systems. In terms of the policy, if both regime destabilisation and niche development are chosen, different policy mixes could be formulated. For example, with each stage of regime stability, a temporally sensitive displacement policy could be developed. Similarly, niches cannot be nurtured in isolation but in parallel with regime destabilisation. Finally, this research contributes to South Africa's deliberation on just transitions (Swilling and Annecke, 2012), which looks at sustainability issues on the continued use of coal, while at the same time promoting low-carbon resilient economic growth. The findings of this research are thus timely and recommend that, for just transitions, both the direction in the decline of coal use, which attends to resistance by incumbents and nurturing low-carbon niches as viable options, are addressed simultaneously.

The next section proceeds with a summary of each chapter, outlining the main findings, followed by the relevance to the overall thesis.

7.2 Summary of all three papers

7.2.1 Summary of Chapter 4 (Paper 1)

The first paper (Chapter 4) addressed the following research question:

How and why did South Africa's MEC become a powerful, entrenched regime?

Chapter 4 is an in-depth case study on the role of mining in the development of the energy sector in South Africa. Specifically, for almost one hundred years, the electricity sector was maintained to support the mining industry and later domestic needs, using coal as the dominant resource. This configuration amongst mining, energy and associated industries formed the MEC. Using a discursive institutionalist approach, Chapter 4 showed that the MEC became a robust system through co-evolution of

ideologies, regulative rules and the accumulation of powerful elites with vested interests in maintaining the status quo.

Insights relevant to the overall thesis

Stability of the regime: high

Some conclusions drawn from this case study have relevance to the overall objective of the thesis in examining regime stability and change. The following sections describe that the establishment of the MEC, which generated a highly stable regime with a dominant incumbent, and the characteristics of 'isomorphic stability'. These are discussed in the next paragraphs, using a format described in the conceptual meta-framework (explained in Chapter 3), which delineated stability into structure and agency, followed by the type of institutional mechanisms observed.

Structure: strong

The structure became established over a period of almost 100 years after which time we could consider it to be strong with a set of core rules and various resources in place to maintain its dominance. Hence, with a strong structure, the reproduction of the core rules has been maintained, given the coherent alignment amongst the regime actors.

Agency: maintenance

As there is a high certainty of field conditions, as well as clear and shared expectations amongst regime actors, this means the state of the regime can be characterised as mature.

Although there were problems, such as commissioning new coal plants or the proposed addition of independent power producers, the regime was able to maintain the normal state of conditions.

The institutional arrangements were homogenous considering the tight configuration and cohesive alignment amongst the actors in the electricity regime, embedded within the MEC.

Given the precise conditions of the organisational field and the limited disturbances within the actor–network composition, regime actors were able to maintain the reproduction of the core rules of the regime, leading to high regime stability.

Institutional reproduction

This chapter has shown that discursive structures, which included ideology, beliefs and interests held by MEC actors, were powerful forces that had substantial influence over the regime's core rules (e.g. routines, policies, laws, societal expectations and values). The electricity regime could be described as having isomorphic stability that exhibits an agreement over regulations, norms and practices amongst the actors in the field. The chapter has discussed the establishment of the country's electricity regime, closely tied to the industrial policy on mining and the developmental objectives of energy access and affordability. Thus, for almost 100 years, at least up until 2008, the status quo was Eskom being the sole supplier of cheap electricity in the country.

7.2.2 Summary of Chapter 5 (Paper 2)

Combining these insights, the next paper in Chapter 5, asked the following:

> *How has Eskom responded to the introduction of renewable energy electricity generation in South Africa?*

Chapter 5 presented a case study of South Africa's electricity regime in which the state-owned utility Eskom attempted to resist the growth of renewable energies in the electricity supply mix. Eskom is a central actor in South Africa's powerful MEC (Chapter 4) (Fine and Rustomjee, 1996) that, amongst other interests, has long-established ties to coal mining together with electricity generation and consumption (Ting, 2015), and it continues to be a significant force in the country's economy (StatsSA, 2017; COM, 2018; Baxter, 2016). However, despite the power of these coal-based interests and Eskom's efforts to resist change over the period from 1998 to 2018, renewable energy-based electricity generation, namely the RE I4P, saw impressive growth, reaching 3.6 GWs of generation capacity as of 2018 (DOE, 2018b). The case study, therefore, provides a useful example of how socio-technical change can be achieved despite the presence of a powerful incumbent.

Insights relevant to the overall thesis

Stability of the regime: high to limited

The following sections describe how the stability of the regime changed from high to limited, demonstrating this through changes in structure and associated types of agency. This paper has shown that as the structure of the regime changed from strong to moderate, different types of agency emerged. It would seem that the dominant regime incumbent, Eskom, tried to maintain the core rules, but as the structure weakened, another regime actor, the DOE, started to reform existing institutions. This demonstrates the constraining and enabling aspects of the structure of the regime and the dynamism of regime stability. These observations are further discussed.

Structure: strong to moderate

In the case study period (1998-2019) that was analysed, it can be argued that the electricity regime began to structurally shift from strong to moderate. Before the 2008 electricity supply crisis, the rules in the electricity regime were intact, as evidenced by the expansion of the two new coals plants (Medupi and Kusile in 2005). Thus, Eskom retained its control over what electricity it could buy, and the Electricity Regulation Act (ERA 2006) remained in place.

However, after 2008, with the electricity regime in crisis, changes started to appear. This was evident in 2011 with the ERA amendment to include a 'new rule' as it introduced the RE I4P. This had the effect of disentangling some aspects of the electricity regime's institutional arrangements, and as Eskom's dominant position was threatened, social legitimacy changed because the regime could no longer continue providing cheap and reliable electricity. The introduction of private sector participation also changed the organisational capital amongst the regime actors. All of these factors had the effect of making the core rules incoherent, and the resources available to the regime actors began to diminish, leading to moderate structure and limited regime stability.

Agency: maintenance and reform

In terms of agency, the field conditions were uncertain due to the electricity crisis, and this affected subsequent actors' preferences, behaviour and responses to corresponding changes.

The addition of the RE I4P resulted in the introduction of new players to the organisational field and, therefore, opened up the regime to a plural set of institutional arrangements. For instance, the increased number of IPPs represented new types of relationships with Eskom. This had consequences, such as opening the regime to new ideas and competing discourses, which, in turn, undermined the reproduction of the rules in the field.

Paper 2 describes how Eskom, the dominant regime incumbent, tried to maintain the core rules through an evolving regime resistance strategy. However, after the persistent electricity crisis, the DOE actively endorsed change through the implementation of the RE I4P, in what could be considered reforming an existing institution. Thus, the combination of a crisis in the field and an increasingly different type of actor, which included private sector developers, indicated the limited regime stability.

Institutional change: coexistence of a niche alongside a dominant incumbent

It was observed that disagreement in its core rules begun to appear, which contributed to limited stability of the regime. Eskom and the DOE, both considered as regime actors, began to be misaligned in their ideas, preferences and interpretations of the core rules, in response to the continued electricity crisis. For instance, their responses diverged, as Eskom tried to maintain dominance through the resistance to changes in the regime. Meanwhile, the DOE was forced to repair the crisis in the electricity regime by supporting the renewable energy programme. In effect, there was a dispersion of efforts within structures that actors had created, which in turn indicated that some regime actors had started to participate in ways other than those prescribed by their taken for granted core rules. Overall, this paper shows that there were signals that, as the structure of the regime became unstable over time, there was a fragmentation amongst the regime actors, as the responses were no longer coherent. The institutional change observed was the RE I4P niche, which coexisted alongside the dominant incumbent,

Eskom, resulting in path altering dynamics in the regime, thus triggering the gradual transformation.

The next paper discusses how the electricity regime responded to the implementation of the Gas I4P programme, which followed closely after the RE I4P.

7.2.3 Summary of Chapter 6 (Paper 3)

In Chapter 6, the following was asked:

> *What explains regime interactions in the course of developing South Africa's LNG for power and industrial use?*

Chapter 6 examined the multiple regime interactions between South Africa's liquid fuel and electricity sectors, which led to the development of the LNG for power generation (Gas I4P) and LNG for industrial use considered as a niche. As has been discussed in Chapters 4 and 5, South Africa's electricity regime has primarily based on coal for generation. However, from 2012 onwards, the electricity regime has seen several changes, of which renewable energy sources were the first implemented, followed by the procurement of other technologies which included gas. In 2015, it was announced that the country would introduce the Gas I4P programme to procure 3.7 GWs of LNG power, which was shortly followed by LNG for industrial use (DOE, 2016). Using a combination of the MLP and institutional theory of conversion, the case study provides an example of how the two regimes, electricity and liquid fuels, actively collaborated in a series of cohesive efforts to support the gas niche.

Insights relevant to the overall thesis

<u>Stability of the regime: limited to low</u>

This paper has shown that regime stability changed from limited to low, and as the structure became weak, the type of agency which had emerged as a reinterpretation of existing rules. This goes to show that the structure of the regime enabled regime actors to contribute to change in ways other than those covered by their taken for granted rules. Overall, this case study demonstrated that regime instability had positive

implications for LNG niche development. This is discussed in detail in the next paragraphs.

Structure: moderate to weak

Structurally, the electricity regime changed from moderate to weak because, by that stage, both renewables and gas had become part of the energy system. This meant the regime actors continued to differ over the core rules. In terms of resources, there was a loss in social legitimacy and trust in Eskom's ability to provide reliable electricity.

Moreover, currently, as the gas programme is being implemented, it will likely alter the electricity regime dimensions of network relations, technology and infrastructure, market rules and search heuristics. This will have consequences on the flow of economic, social and political resources of the coal-based regime. Thus, the structure of the regime will change from moderate to weak, contributing to low regime stability.

Agency: reinterpretation

This case study showed that, in 2015, the field conditions were more uncertain due to the persistent electricity crisis, and the introduction of both renewables and gas could be viewed as technological disruption against the dominant coal-based electricity regime.

The actor–network composition has become progressively more complex due to IPPs from renewables and gas in the system. Arguably, in this complex set of actors, there are different sources of competing interests, perceptions and motivations in the regime selection environment. Thus, with the experience and learning gained from the RE I4P, some regime actors, such as the DOE, have begun to change their ideas, the rationale of their interests' preferences or even their identity, such that reinterpretation of existing rules has become evident. The evidence for this was articulated in IRP of 2013, which clearly stated that, due to new development in gas (Mozambique gas reserves, as well as the United States potentially exporting gas) from 2010 onwards, the gas would be preferred over diesel because of the rising coal costs for electricity generation (DOE, 2013).

Chapter 6 has shown that repurposing existing institutions was necessary to develop the LNG niche. Moreover, repurposing was no easy task but required an ongoing interface between a broad-based community that has interests in the LNG niche, which includes various government departments and the private sector, which over time have provided a supportive environment in which to complement shared resources. Examples of these include technical knowledge, operational processes and funding mechanisms shared between the two regimes.

Likewise, in terms of actor coalition, the DOE has started to align its electricity plans to a much broader set of community members, as made clear by the gas-to-power and gas for industry plans of the DTI. Again, this goes to show that the DOE has become consciously diverse in their plans to end the electricity crisis in the country. With an uncertain field condition and an increasing set of heterogeneous actors, the regime has opened up to various interests, perceptions and ideas, leading to limited stability.

Institutional changes: repurposed existing institutions

This paper demonstrated that a further deterioration of the regime, as evidenced by its moderate to weak structure, can be exploited by strategic actors in ways other than those dictated by their taken for granted rules. Consequently, repurposing existing institutions between the two regimes necessitated the development of a niche. In other words, a weakened regime has opened up in a way that was previously constrained by structural features, has thus enabled the regime actors to reinterpret existing rules by supporting the LNG niche. Reinterpretation means that the regime actors strategically enacted existing rules differently, as was apparent by the DOE repurposing the IPP policy instrument, followed by redirection of cognitive and normative rules. Moreover, Chapter 6 has shown that repurposing existing rules was by no means a straightforward process but entailed a series of alignment of efforts, which enabled a multi-regime interaction between electricity and liquid fuels. In sum, as the regime opened itself to more diverse set actors and institutional arrangements, different sources of competing interests, perceptions and motivations developed. Thus, when the regime has low stability, and conditions are uncertain, it is conceivable that powerful actors could seize the opportunity by influencing transitions towards their interests. Therefore, by opening

up the regime to the extent that its structure became weak, the types of changes would be dependent on the actors present in the regime's organisational field.

Likewise, ST research suggests that regime instability can increase opportunities for a niche, or as Raven (2005) argued, too much regime instability leads to diminished niche development. In this research, regime instability was found to lead to niche development because, arguably, the DOE was a powerful actor, and the continued electricity crisis demanded solutions that no longer adhered to the norm. In this way, the features of breaking away from cognitive lock-in had begun the process of searching for solutions other than coal, or even 'fit and conform', such as renewables. However, the gas would require alignment with an industrial strategy in the country (with varying implications of scale – regional, national and local – and sectors – petrochemicals, steel and fertilisers – amongst others). Given this, using an endogenous institutional theory was essential to reveal how the regime responded to shifting internal and external pressures, and could, therefore, be useful in developing strategies that favour niche breakthroughs. Thus, as there was a weak regime structure, there became a space for electricity regime actors to interpret the set of existing rules and resources differently. In this state, opportunities emerged for a niche, but this was dependent on the alignment of perceived interests amongst existing regime actors. Therefore, strategies for niche development need to consider regime interests or enable regime decline, such that niches become viable options that regime actors can support.

6.2.4 Summary of the three papers

In sum, there has been an evolution of regime stability, from high in the first paper, limited in the second, towards low stability in the third. The institutional change identified in the second paper showed disagreement on the rules of the regime, as both resistance by Eskom and coexistence of a new rule supported by DOE were noticeable. ST literature would suggest that divergence or misalignment in rules is a source of tension in a regime which can lead to regime change. Thus, the second paper, which described the regime in a state of crisis, uncertain field conditions, the addition of new actors and limited regime stability, would imply that a fragmentation amongst the regime actors has begun to appear. The third paper indicates that, with the addition of the gas programme, there has been further technological disruption and an increasingly

complex set of institutional arrangements leading to low regime stability. The implication is that, as the regime opens up, there are then more actors in the organisation field, which are sources of various interests, levels of awareness and intentions. Furthermore, opening up the regime can lead to the emergence of different types of institutional changes, as was shown in Papers 2 and 3.

The results of this research suggest that the cumulative regime instability (from limited to low regime stability) has led to a process of disintegration, as there are signs that the regime's core rules are incoherent. For instance, it is still not clear what the various shares will be for coal, gas, renewables and other technologies in the country's future energy generation mix. With this uncertainty, the field conditions are becoming complex, and evaluating the risks associated with the continued use of the coal-based electricity regime remains uncertain. There could also be diverse technology-based scenarios, in which an adjusted or new regulatory framework is needed. Overall, early features of a destabilised electricity regime point towards an institutional change called displacement. In the next section, I will discuss displacement using literature that is derived from the latest government updates and news articles.

7.3 Displacement

Displacement represents the ultimate form of institutional change, in which new rules replace old ones. In STs, this can mean the complete destabilisation of an existing regime and replacement by a niche. Taking into consideration the cumulative changes observed in Chapters 4-6, a discussion on displacement is necessary to provide a fuller and more nuanced implication of what effect this may have on regime stability and change.

In addition to the inclusion of renewables and gas, there are empirical indications from the updated IRP of August 2018 that there will be a decommissioning of Eskom's existing coal fleets. However, by no means is this a determinate direction whereby displacement of coal by sustainable energy technologies is guaranteed in the South African case. It has been stated that the average age of Eskom's generation fleet is around 37 years, and hence reasonably mature (Eskom, 2013b; DOE, 2018a). The IRP has indicated that 75% of Eskom's current coal fleet is scheduled for decommissioning by 2040 and some older plants are due to be closed as early as 2021 (Figure 7.1) (DOE, 2018a, p. 62). In Figure

7.1, each bar that is represented illustrates the amount in GWs of Eskom's existing coal fleets, which are to be decommissioned relative to that year.

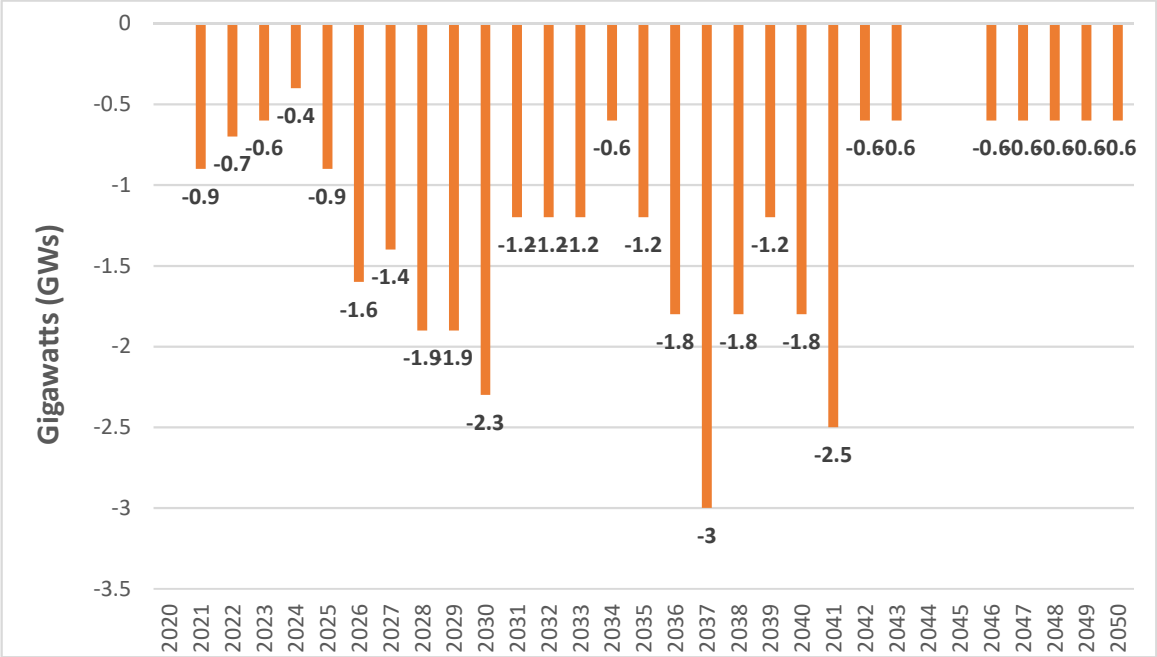


Figure 7.1: IRP-2018 for Eskom's coal fleet decommissioning up to 2050 (DOE, 2018a, p. 62).

The main question articulated by the IRP-2018 is what resources will substitute for the void. One issue being investigated is the security of supply, which is set against the country's plan to decarbonise the electricity sector (DOE, 2018a, p. 62). Steyn et al. (2017) stated that, given the long lead time in commissioning Medupi and Kusile, there is a risk of stranded assets, as well as surplus capacity, due to a decline in the country's overall electricity demand. Hence, a suggestion is that, to meet the uncertain electricity demand, modular and flexible generation methods demanding less lead time are needed in future builds, which will be best achieved through renewable energy, battery storage and open-cycle gas turbines (Steyn et al., 2017). Therefore, it would seem that according to scholars such as Steyn et al. (2017), the continuation of using coal is increasingly being questioned given the plans for new gas and renewable energy sources, amongst others. This research considers that South Africa's coal-fired electricity regime is now heading towards partial displacement since there are features of substantial alterations. Examples of these are increasing IPPs, plans for unbundling Eskom and decommissioning ageing coal fleets.

Insights relevant to the overall thesis

Regime stability: low

As of 2019, the electricity regime is still characterised as fractured because South Africa has shared energy resources amongst coal, renewables and gas over the period analysed to this date. In this regard, the stability of the coal-based electricity regime is considered low, with highly uncertain field conditions. These points are elaborated below.

Structure: weak

Eskom represents 17% of the total sovereign debt and is close to insolvency, which can have a detrimental impact on the country's credit rating (Eskom, 2019). Furthermore, Eskom is struggling to maintain operational stability,[57] its sales volume has decreased,[58] and its business model is outdated. Subsequently, in line with a growing need to respond to Eskom's worsening conditions, on February 2019, the South African President Cyril Ramaphosa promoted the unbundling of Eskom into three separate entities of generation, transmission and distribution subject to stakeholder engagement (see Appendix E).[59] Thus, the core rule of Eskom being the supplier of last resort and provider of cheap and reliable electricity is becoming increasingly untenable. Hence, a decline in economic resources and a gradual loss of political and public support are examples of how the regime structure is weak.

Agency: defection

Empirically, there are signs of unbundling Eskom, but for almost one year, the latest IRP-2018 has remained protracted, and the country has no plans for mitigating the intermittent blackouts.[60] Thus, the finalisation of the IRP continues to be delayed, partly

[57] DONNELLY, L. 2019. *DPE issues correction: Eskom not insolvent, but has "liquidity challenges"* [Online]. Mail and Guardian. Available: https://mg.co.za/article/2019-02-13-dpe-issues-correction-eskom-not-insolvent-but-has-liquidity-challenges/ [Accessed 1 August 2019].

[58] ESKOM 2017. Eskom 2018/19 Revenue Application Stakeholder Discussion.

[59] PRESIDENCY, T. 2019. State of the Nation Address by President Cyril Ramaphosa

[60] CREAMER, T. 2019a. *IRP to be out of date by time of Cabinet approval as a result of protracted talks* [Online]. Available: https://www.miningweekly.com/article/irp-to-be-out-of-

due to the powerful National Economic Development and Labour Council's (NEDLAC, see also Chapter 4) concerns about the limited use of coal, particularly as there are job losses associated with it.[61] In essence, there is disagreement over the shares of renewables and coal in the country's electricity regime between the DOE and business versus labour represented by the trade unions.[62] In such cases, these are conditions which are highly uncertain, such that regime actors are not able to diagnose nor anticipate the risks to the system. Therefore, some early features of defection from the core rules are evident. In this circumstance, regime stability is low and open to a variety of unpredictable changes.

Institutional changes: early features of partial displacement

South Africa's coal-based electricity regime is undergoing early features of destabilisation. Displacement represents the ultimate form of transition, and in this research, this feature has been found to characterise cumulative changes over time. Thus, each of the institutional changes observed, which includes coexistence with an incumbent and repurposing existing institutions, has contributed to radical changes. Therefore, wholesale change from a niche to a regime, as STs suggests, has in this case study emerged as the fractured form of a destabilised regime. Moreover, in this fractured state, the transition is ongoing, as there are numerous uncertainties, and as yet there is no resolution included in the country's future electricity plans.

7.4 Concluding statements

One of the general concluding insights that have emerged is that changes in the regime involved complex endogenous processes. Hence, the traditional view of seeing socio-

---

date-by-time-of-cabinet-approval-as-a-result-of-protracted-talks-2019-07-24/rep_id:3650 [Accessed 1 August 2019].

[61] CREAMER, T. 2019b. *IRP will serve before Cabinet only in September as Nedlac process drags on* [Online]. Available: https://www.engineeringnews.co.za/article/irp-will-serve-before-cabinet-only-in-september-as-nedlac-process-drags-on-2019-07-11 [Accessed 1 August 2019].

[62] YELLAN, C. & LILEY, R. 2019. *Paralysis over South Africa's IRP for electricity presents massive economic risk* [Online]. Available: https://www.dailymaverick.co.za/article/2019-01-17-paralysis-over-south-africas-irp-for-electricity-presents-massive-economic-risk/ [Accessed 1 August 2019].

technical change as a punctuated equilibrium, where radical innovation takes place in the niche, may miss out on how the regime deliberates and negotiates the shifting pressures occurring both internally and externally to the regime. Using an endogenous institutional theory, the research was able to comprehensively investigate the regime, such that different kinds of changes became evident. The benefit of using this approach provided insights into specific parts of the regime which had enabled resistance, such as discursive structures, the ways in which the regime became fractured over time and the dynamic and emergent nature of the regime–niche interactions. These are discussed in the subsequent paragraphs.

7.4.1 Theoretical contributions

Fractured regime: a gradual form of disintegration

This thesis has shown that regime destabilisation emerged as a fractured regime, as there is the coexistence of the coal incumbent with the niches of RE I4P and Gas I4P, by way of the country's present and future electricity generation plans (Papers 2-3). There is evidence to suggest that the structure of the regime has progressively changed from strong to moderate and then to weak. Arguably, the fractured electricity regime is indicative of the difficulty in trying to achieve sustainability changes in South Africa. This is apparent through the empirical cases of resistance by the incumbent, coexistence with renewables, repurposing existing institutions and early features of displacement. Thus, in contrast to the assumed punctuated equilibrium change associated with the regime, destabilisation in this context was a gradual form of disintegration. The maintenance of core rules was possible when the structural conditions of the electricity regime were relatively stable. However, where the structure of electricity regime became moderate to weak, then regime actors began to *reform* and *reinterpret* and started to *defect* from established practices, routines and core assumptions and beliefs. This may help to explain why the electricity regime had resisted change but also participated in supporting the gas niche, which was dependent on the structural conditions over time. The fractured regime observed in this case study contributes to broader research on the types of regime which are present in the Global South context (Wieczorek, 2018), where conditions are often fluid, messy and unpredictable. In this

instance, the changes observed were highly contested and fraught due to various dimensions (markets, organisation networks, discursive structures, public policies and infrastructure) along with the regime selection environment.

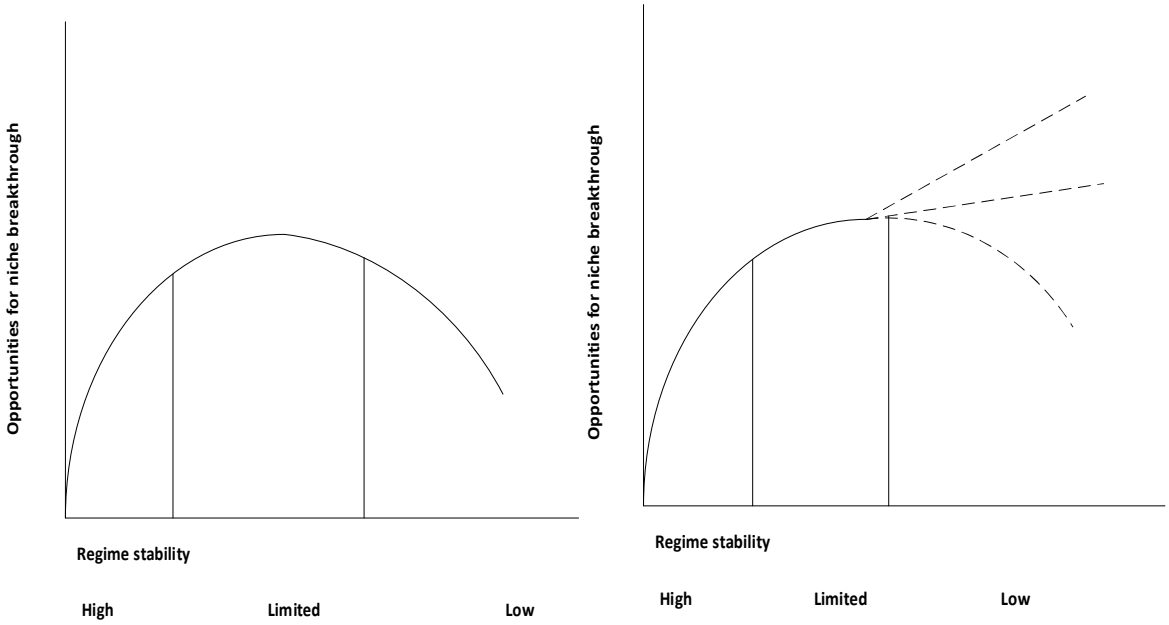
Selection environment: discourse and transparency

The interaction amongst discourse, institutional context and interests, which formed the discursive structure in the MEC, was a formidable obstacle to change. The discourse around mining and energy, in line with state developmental objectives and in combination with an endorsement from industry and trade unions, constituted a powerful core regime alliance (Papers 1-2). The empirical cases showed that the discursive structures were perpetuated by regime actors present in the MEC who had vested interests and associated ideologies and beliefs in maintaining regime stability. Nevertheless, as Paper 2 has revealed, there are also strategies which could be formulated to counter such parts of regime maintenance and resistance, by opening up the regime to more public scrutiny, which can create conditions that exacerbate the tensions within the incumbent. Broadening these insights further, discourse and transparency could be entry points as the basis for developing counter strategies to regime resistance, which may achieve some degree of regime destabilisation. Future research is needed on how discursive structures and other dimensions of the regime selection environment reveal similar or different dynamics in other kinds of regimes.

Regime–niche interaction is dynamic and emergent

Earlier work of the MLP assumes that, as the regime destabilises, there is then an opportunity for niches. Thus, the assumption is that there is a proportional relationship, which means the more significant the instability of the regime, the greater the opportunity for niches. Conversely, Raven (2005) posited that the relationship between a regime and niche could be paradoxical, in that too much regime instability causes a decrease in niche opportunity. These assertions are helpful, but not explicit in how regime instability leads to regime change. This research postulates a more nuanced assumption, as the findings reveal that the levels of regime instability resulted in different institutional changes, and by implication, niche opportunities (Figure 7.2). For instance, in Paper 2, Eskom was found to have tried to defend the cracks in the electricity

regime by resisting RE I4P. However, as the electricity regime continued to weaken, Eskom's position diminished, allowing the DOE, another regime actor, space to manoeuvre in a way that it became receptive to changes, such as the coexistence of the RE I4P alongside Eskom (Paper 2) and later the repurposing of existing rules to develop the LNG niche (Paper 3). The suggestion is that transitions develop in many directions, of which sustainability is just one such form.



A B

Figure 7.2 Relationship between regime stability and niche opportunities defined by Raven (2005). A depiction of Raven's hypothesis (A) versus the findings in the current research (B). The dotted lines depend on the ongoing mediation between strategic actors

Moreover, as the type of actors became heterogenous in the organisational field, so did an increase in opportunity for strategic negotiation and deliberation amongst the actors. This was the case when South Africa introduced renewables and later gas, resulting in private sector participation in the electricity regime. The suggestion here is that changes in actor network compositions and actor coalitions could lead to different types of regime changes. Thus, in this case, study, the regime–niche interactions were emergent and dynamic, which could result in niche contraction or expansion. Thus, as the regime

opens up over time, there are then more actors (with varying interests, ideas, preferences and values) in the organisational field, contributing to various opportunities for strategic deliberation. Therefore, the relationship between regime disintegration and niche opportunities requires finer nuances because the outcomes are dependent on field conditions, types of actors present in the field and temporal sequences that may already have unfolded. These kinds of empirical insights from the case study contrast with the notion of a regime as monolithic or inert, and instead, show that it is actively resistant and resourceful. Hence, more research is needed, which examines evolving regime resistance or regime endorsement of a niche in different empirical contexts.

7.4.2 Empirical contributions

This study has shown that South Africa's electricity sector is in a state of considerable flux, where numerous developments are occurring at various times. It has, therefore, contributed to limited empirical findings on South Africa's case studies on renewable energy and gas against the coal-entrenched regime.

Moreover, South Africa is now implementing a just transitions pathway, that will enable the country to move towards becoming a low-carbon resilient society.[63] Related to energy, some issues that required addressing were the continuation of fossil fuel-based energy systems, increasing electricity tariffs, energy access, and suitability of Eskom as a monopoly. Some of the plans proposed were to set deep decarbonisation targets for the country, which ultimately will lead to a net zero carbon emission pathway.[64] The findings of this research thus come at an opportune time because the kinds of issues examined, such as incumbent resistance, together with niche opportunities, are in line with the country's ambitions for just transitions. This research suggests that to move the country forward towards a low-carbon resilient society, a systemic change in various electricity regime dimensions, such as the market, organisational networks, discursive structures, policies and infrastructure, is needed. This can include certainty in the market rules, disrupting existing organisational networks aligned to mining and energy,

[63] National Planning Commission (NPC), Chapter 5, Transitions to a low-carbon economy. https://www.nationalplanningcommission.org.za/assets/Documents/NDP_Chapters/devplan_ch5_0.pdf
[64] Developing models and pathways for a low-carbon economy and resilient society. https://www.sustainable.org.za/project.php?id=55

developing a discourse on alternative resources for electricity generation other than coal, aligning policies, targets or standards that enable sustainable technologies and, finally, adopting technologies and infrastructure that cater to flexible, modular, and decentralised demand. In effect, a deep transition would require changes in the regulative, cognitive and normative lock-in that has pervaded the country's energy landscape for several decades.

7.4.3 Policy recommendations

The destabilisation of a regime needs to take into consideration both winners (niches) and losers (regime) from the transition. As such, both the decline in the use of coal and stimulating alternative green options must be tackled simultaneously. This can then move the country in a direction towards sustainable development. Directionality means there are deliberate attempts to abandon existing pathways because failing to do so can mean existing trajectories may simply be replicated or extended.

In this regard, this question could be asked: What kind of policies would be needed to enhance structural weakness in the regime, and thereby stimulate an agency directed towards institutional change? The answer may, in turn, facilitate the decline of the regime, and thereby accelerate the desired sustainable transition. Here, a suggestion is to consider a temporally sensitive displacement policy mix that could lead to complete regime destabilisation. By this, I mean that different types of policies are formulated and implemented depending on the relative stability of the regime. If, for example, the structural conditions are not conducive for incumbents to defect from or abandon core rules, policies can attend to mitigating resistance by regimes or providing incentives for incumbents. However, if the regime is more receptive to changes, or there is a period of instability, a layered approach could be considered, as a fit and conform strategy. If the regime opens up more, or there is limited to low stability, there needs to be a policy that can induce persistent destabilisation. This can include a combination of phase-out policies (Rogge and Johnstone, 2017), creative destruction (Kivimaa and Kern, 2016) and discontinuation governance (Stegmaier et al., 2014), instead of sweeping initiatives that lack consideration of regime stability conditions. There are then different types of displacement policies that are more effective and appropriate.

For those on the losing end of a transition, specific policies are needed that can provide viable alternatives. For example, several studies are now addressing the potential impact of coal phase-out in various communities (UNEP, 2017). Some proposals include unemployment insurance for displaced workers (Louie and Pearce, 2016), coal phase-out agreements, the establishment of worker transition centres (Wiseman et al., 2017) and a coal exit commission that has social protection and economic diversification plan,[65] amongst others. South Africa would need to address specific regional parts of the country that are most vulnerable to coal phase-out, particularly the resistance by the powerful trade unions. Perhaps that can include a social contract which involves government, business and local communities, which includes a road map for gradual the phase-out of coal, with some forms of social protection and a reskilling programme for regional diversification.

7.4.4 Limitations and future research

Socio-technical systems are, by definition, comprised of material and social elements (e.g. technologies, market institutions, user practices, societal values, etc.), each of which evolves interdependently with the others over time. Analysis of socio-technical systems, therefore, requires attention to all the elements and their interdependent co-evolution. Still, there is no standard method stipulating what the balance of attention across the elements should be. That is, there is no standard method specifying, for example, that each element should receive equal treatment in the analysis. Instead, the balance of attention is an analytical decision dependent on the focus of any specific research enquiry. For this thesis, I focussed on regime stability and change in terms of structural dynamics and kinds of agency in the face of regime internal and external pressures. The critical co-evolutionary process at the heart of this focus was that between the electricity regime's stability and its core rules, revealed by following the strategic efforts of regime actors trying to maintain or shape the selection environment that would most likely ensure regime stability. Thus, my analytical decision was to provide enough detail on the technical change that the reader could understand these

[65] Commission on growth, structural change and employment. https://www.bmwi.de/Redaktion/EN/Publikationen/commission-on-growth-structural-change-and-employment.html

dynamics, both in contextual terms and in terms of specific actor efforts, while leaving enough space for a thorough examination of the dynamics of regime stability. Consequently, my analysis is less 'technical' and more 'social' than many other socio-technical analyses, relying instead on broad characteristics of technologies as sufficient for the reader to grasp the significance of specific pressures: e.g. the threat of a renewables-based electricity niche to the dominance of a mainly coal-fired electricity regime, especially in the context of a need for climate change mitigation and, for example, the more specific rapid reductions in costs of renewables. A more detailed analysis of the micro developments of technologies and technological change would have been possible. Still, I would argue that such detail would not be necessary to understand the different types of threats (from renewables) or opportunities (with gas) facing the coal-based regime. Therefore, I gave the 'technical' a minor role in my analysis, allowing enough space for a detailed analysis of the relationships between rule changes, actor strategies, structural dynamics, and regime stability and change.

In term of limitations, this thesis described the findings from a single country study, and could, therefore, be further expanded with cross-country comparisons. Moreover, there is a limitation in how other technologies, such as nuclear, biogas and hydropower, relate to the overall electricity regime transformation.

If the fossil fuel-based regime continues as it currently is, it appears that gas could outcompete renewables in the future. As it has been shown, South Africa's electricity regime transitions unfolded at first with a hopeful change of introducing the RE I4P. However, what followed was that the electricity regime became receptive to other resources such as gas, amongst others, as part of diversifying the electricity generation mix. This means that changes in the regime are open to fossil fuel interests, whereby new or varying permutations of transitions can occur.

Relatedly, in South Africa, much of what determines electricity reform is closely tied to its industrial policy. If it indeed pursues or continues to lock itself into energy-intensive primary sector-driven mining activities, it may miss the opportunity to shift the economy to address its triple challenge of reducing inequality, addressing job creation and reducing poverty. As of August 2019, the country has reached its highest unemployment

rate in the last two decades, as it now stands at 29%.[66] It seems the country is at a tipping point, and its electricity crisis is part of a much broader socio-economic development challenge. More research is needed that considers industrial and energy policies together, such as low-carbon resilient economic growth. This may enable a shift to labour absorptive industries, while simultaneously addressing its climate change goals.

In terms of expanding on the theoretical insights, I suggest that the strand of research on linking agency to different types of institutional work would be useful in complementing the empirical and theoretical contributions (Lawrence, 2006; Battilana and D'Aunno, 2009). Expansion of the current research could explore the varying levels of the structural weakness of the regime, and the types of rule changes observed can be linked to the institutional work of creation, maintenance and disruption (Lawrence, 2006). Hence, there is a potential to develop a typology of regime change, whereby specific rules are linked to different types of institutional work, one in which resistance, redirecting and nurturing niches are investigated. It seems that, with a highly resistant regime, a system could be vulnerable to intermittent crises, and this can lead to opening up spaces for niche development. The solution could be through layering if a niche is readily available or has had some prior introduction. However, if no such niches are available, repurposing could follow, provided there are existing policy instruments, or if the infrastructure is amenable for repurposing. This may explain why, in this case, study, a layered approach was feasible because the RE I4P was sufficiently developed. Lastly, displacement could be conceived as systematic destabilisation of the regime, such that resistance and niche development are both addressed. As the case studies have shown, these changes are dependent on the underlying institutional settings in which the rules are embedded. Moreover, as changes are subject to ongoing mediation amongst actors, which tend to favour those who have more significant resources in terms of social, political and financial capital, future research on different types of changes would enrich the conceptual framework developed in this study.

[66] StatsSA, Quarter Labour Force Survey (QLFS) for the second quarter of 2019, http://www.statssa.gov.za/?p=12376

This research could also contribute to a contemporary research agenda of transformative innovation policy (TIP).[67] Here, TIP examines new innovation policies that aim to go beyond the market failure or the national system's innovation approach. Instead, the focus is on social needs at the forefront of formulating policies. Part of this research agenda is finding new ways of opening up the regime and unlocking path dependencies through various experimental forms in policy engagements that include unlearning and being reflexive of existing routines, practices and directionality (deliberate attempts to abandon existing pathways) (Schot and Steinmueller, 2018). The findings of this research show the dynamism of regime actions which have emerged associated with different institutional changes as the regime became unstable. These types of efforts, such as resistance, layering, repurposing, and defection, can contribute to TIP research in opening up the regime.

Lastly, opening up the regime could benefit by mobilising social movement theory, drawing on 'non-institutionalised' forms of a coalition, such as strikes, protests and petitions (Geels, 2010, p. 506). As shown in this research, discursive structures were essential parts of the regime that enabled resistance but were also parts by which the niche could develop counter strategies, such as increased public scrutiny and exacerbating regime tension. Thus, social movements can be effective means to frame discourses against an incumbent or to nurture niches through public channels (Hess, 2014). More research is needed which pays attention to non-institutionalised forms of action, with an emphasis on civic participation that is effective in contesting dominant narratives and ideologies. Perhaps effective strategies for regime destabilisation could take note of increasingly organised civil society coalitions, such as extinction rebellion and divestment campaigns, as part of the narratives in addressing climate change as an emergency.

7.4.5. Summary

In conclusion, this thesis has revealed the enormous challenge that a country, such as South Africa, must face in trying to achieve a more sustainable electricity regime. Mining and energy have been intimately tied to the country's socio-economic development

[67] Transformative Innovation Policy Consortium (TIPC) http://www.tipconsortium.net/

plans for many decades. However, contemporary challenges that place demands on countries to move away from fossil fuel-based industries, as part of the broader SDGs is fast approaching. The ambition to reach the SDGs by 2030 seems a daunting task, particularly for developing countries that need to balance trade-offs and synergies amongst multiple priorities, such as inequality, job creation and poverty reduction. This research has delineated the kind of changes that unfold when a regime undergoes various challenges over time. Given this complexity, it is essential that more research attends to inter-disciplinary theoretical frames that include power and politics, as well as social, cultural and market dimensions and that appreciate the dynamism in socio-technical change. Doing so can generate knowledge, practices and experiences that are both socially engaged and empirically grounded, which may enable an accelerated socio-technical transition.

REFERENCES

ANC 2012. African National Congress (ANC): State Intervention in the Minerals Sector (SIMS).

ANDREWS-SPEED, P., 2016. Applying institutional theory to the low-carbon energy transition. *Energy Research & Social Science,* 13**,** 216-225.

ASHMAN, S., FINE, B. & NEWMAN, S. 2011. The Crisis in South Africa: Neoliberalism, Financialization, and Uneven and Combined Development. *Socialist Register,* 47**,** 174–195.

AVELINO, F., 2011. *Power in Transition: Empowering discourses on sustainability transitions.* PhD PhD, Erasmus University.

BAKER, L., 2014. Renewable energy in South Africa's minerals-energy complex: a 'low carbon' transition? *Review of African Political Economy,* 42**,** 245-261.

BAKER, L., NEWELL, P. & PHILLIPS, J., 2014. The Political Economy of Energy Transitions: The Case of South Africa. *New Political Economy,* 19**,** 791-818.

BATTILANA, J. & D'AUNNO, T., 2009. Institutional work and the paradox of embedded agency. *In:* LECA, B., SUDDABY, R. & LAWRENCE, T. B. (eds.) *Institutional Work: Actors and Agency in Institutional Studies of Organizations.* Cambridge: Cambridge University Press.

BAXTER, R., 2016. *Mining in South Africa, the challenges and the opportunities* [Online]. Chamber of Mines of South Africa. Available: http://www.mineralscouncil.org.za/industry-news/publications/presentations [Accessed 2 April 2019].

BERGGREN, C., MAGNUSSON, T. & SUSHANDOYO, D. 2015. Transition pathways revisited: established firms as multi-level actors in the heavy vehicle industry. *Research policy,* 44**,** 1017-1028.

BHORAT, H., BUTHELEZI, M., CHIPKIN, I., DUMA, L. M., QOBO, M. & SWILLING, M. 2017. Betrayal of the Promise: How South Africa is being stolen. Public Affairs Research Institute

BOSMAN, R., LOORBACH, D., FRANTZESKAKI, N. & PISTORIUS, T. 2014. Discursive regime dynamics in the Dutch energy transition. *Environmental Innovation and Societal Transitions,* 13**,** 45-59.

BROAD, D. S., AND MILLS, S.R. 1993. South Africa offers exploratory potential in a variety of basins. *Oil and Gas Journal***,** 38-44.

BUDELI, M., 2012. Trade Unionism and Politics in Africa: the South African Experience. *The Comparative and International Law Journal of Southern Africa,* 45**,** 454–481.

BUDLENDER, G., 2017. Allegation with regard to the Trillian Group of companies, and related matters.

BUHLUNGU, S., 2008. Gaining Influence but Losing Power? COSATU Members and the Democratic Transformation of South Africa 1. *Social Movement Studies,* 7**,** 31-42.

BUHLUNGU, S., SOUTHALL, R. & WEBSTER, E. 2008. Cosatu and the democratic transformation of South Africa. *In:* BUHLUNGU, S. E. (ed.) *Trade Unions and Democracy, Cosatu Workers Political Attitudes in South Africa.* Cape Town.

BURDEN, P. L. A., 1992. Soekor, partners explore possibilities in Bredasdorp basin off South Africa. *South Africa, Oil and Gas Journal***,** 109-112.

BURTON, J. & WINKLER, H., 2014. South Africa's planned coal infrastructure expansion: drivers, dynamics and impacts on greenhouse gas emissions. University of Cape Town (UCT), South Africa: Energy Research Centre (ERC).

BYRNE, R., 2011. Learning drivers: rural electrification regime building in Kenya and Tanzania. DPhil Thesis, University of Sussex.

CHERRY, J. 2006. Workers and policymaking. *In:* BUHLUNGU, S. (ed.) *Trade unions and democracy: Cosatu workers political attitudes in South Africa.* Cape Town, South Africa: HSRC.

COLLIER, P., 2007. *The Bottom Billion: Why the Poorest Countries Are failing and What Can Be Done About It,* Oxford, UK, Oxford University Press.

COM 2018. National Coal Strategy for South Africa *Coal Strategy, 2018* Chamber of Mines South Africa.

COSATU 2015. Organisational report to the 12th National Congress. "Unity and Cohesion of COSATU to advance the National Democratic Revolution (NDR) for Socialism".

CREAMER, T., 2011. Eskom lobbying for a new coal dispensation to shore up domestic supply. *Engineering news*.

CREAMER, 2016, Eskom challenges 'unfair' state capture claims [Online]. Available: https://www.miningweekly.com/article/eskom-challenges-unfair-state-capture-claims-2016-04-19/rep_id:3650 [Accessed 1 August 2019]

CREAMER, T. 2019a. *IRP to be out of date by the time of Cabinet approval as a result of protracted talks* [Online]. Available: https://www.miningweekly.com/article/irp-to-be-out-of-date-by-time-of-cabinet-approval-as-a-result-of-protracted-talks-2019-07-24/rep_id:3650 [Accessed 1 August 2019].

CREAMER, T. 2019b. *IRP will serve before Cabinet only in September as Nedlac process drags on* [Online]. Available: https://www.engineeringnews.co.za/article/irp-will-serve-before-cabinet-only-in-september-as-nedlac-process-drags-on-2019-07-11 [Accessed 1 August 2019].

DAVID, P., 1985. Clio and the Economics of QWERTY. *The American Economic Review,* 75**,** 332.

DAVIDSON, O., 2006. Energy Policy *In* WINKLER, H. E. (ed.) *Energy Policies for Sustainable Development in South Africa. Options for the Future.* Cape Town: Energy Research Centre (ERC).

DEDT 2013. Pre-feasibility report for the importation of natural gas into the Western Cape with a specific focus on the Saldanha Bay-Cape Town corridor. DEPARTMENT OF ECONOMIC DEVELOPMENT AND TOURISM (DEDT), Western Cape, South Africa.

Deloitte (2015), The socio-economic impact of importing LNG into the West Coast of the Western Cape. Report prepared for the Western Cape Department of Economic Development and Tourism.

DIERCKS, G., LARSEN, H. & STEWARD, F. 2019. Transformative innovation policy: Addressing variety in an emerging policy paradigm. *Research Policy,* 48**,** 880-894.

DIMAGGIO, P. J. & POWELL, W. W., 1983. The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review,* 48**,** 147-160.

DME 1998. White Paper on the Energy Policy. DEPARTMENT OF MINERALS AND ENERGY (DME), Pretoria, South Africa.

DMR 2005. Gas Infrastructure Plan (GIP). DEPARTMENT OF MINERALS AND RESOURCES (DMR), Pretoria, South Africa.

DMR 2013. Annual report. DEPARTMENT OF MINERAL RESOURCES (DMR), Pretoria, South Africa.

DOE 2010. Strategic Plan 2010/11–2012/13. DEPARTMENT OF ENERGY (DOE), Pretoria, South Africa.

DOE 2012. Second National Energy Efficiency Strategy of the Republic of South Africa. DEPARTMENT OF ENERGY (DOE), Pretoria, South Africa.

DOE 2013a. Integrated Resource Plan (IRP) update. DEPARTMENT OF ENERGY (DOE), Pretoria, South Africa.

DOE 2013b. South Africa energy price report, Directorate: energy data collection, management and analysis. DEPARTMENT OF ENERGY (DOE), Pretoria, South Africa.

DOE 2014. Russia and South Africa sign agreement on Strategic Partnership in nuclear energy, Media release. Department of Energy (DOE). Pretoria, South Africa. Available: http://www.energy.gov.za/files/media/pr/2014/MediaRelease-Russia-and-SA-sign-agreement-on-Strategic-Partnership-in-Nuclear-Energy-22September-2014.pdf [Accessed 1 August 2019]

DOE 2015a. Renewable energy IPP Procurement Programme, Bid window 4, preferred bidders' announcement. DEPARTMENT OF ENERGY (DOE), Pretoria, South Africa

DOE 2015b. State of Renewable energy in South Africa. Pretoria, DEPARTMENT OF ENERGY (DOE), Pretoria, South Africa.

DOE 2016a. Independent Power Producer Procurement Office, Information Memorandum for New Generation capacity for the LNG to Power.DEPARTMENT OF ENERGY (DOE), Pretoria, South Africa.

DOE 2016b. Integrated Energy Plan (IEP). DEPARTMENT OF ENERGY (DOE), Pretoria, South Africa.

DOE 2018a. Integrated Resources Plan. DEPARTMENT OF ENERGY (DOE), Pretoria, South Africa.

DOE 2018b. South African Energy sector report. DEPARTMENT OF ENERGY (DOE), Pretoria, South Africa.

DONNELLY, L., 2019. *DPE issues correction: Eskom not insolvent but has "liquidity challenges"* [Online]. Mail and Guardian. Available: https://mg.co.za/article/2019-02-13-dpe-issues-correction-eskom-not-insolvent-but-has-liquidity-challenges/ [Accessed 1 August 2019].

DORIGONI, S., GRAZIANO, C. & PONTONI, F. 2010. Can LNG increase competitiveness in the natural gas market? (Report). *Energy Policy,* 38**,** 7653-7664.

DOSI, G., 1982. Technological Paradigms and Technological Trajectories: A Suggested Interpretation of the Determinants and Directions of Technical Change. *Research Policy,* 11**,** 147.

DTI 2013. The dti electricity pricing report. DEPARTMENT OF TRADE AND INDUSTRY (DTI), Pretoria, South Africa.

DTI 2018. Industrial Policy Action Plan (IPAP): 2018/19-2020/21. DEPARTMENT OF TRADE AND INDUSTRY (DTI), Pretoria, South Africa.

EBERHARD, A., 2007. The political economy of power sector reform in South Africa. *In:* VICTOR, D. G. & HELLER, T. C. (eds.) *The Political Economy of Power Sector Reform: The Experiences of Five Major Developing Countries.* Cambridge: Cambridge University Press.

EBERHARD, A., 2011. The future of South African coal: market, investment, and policy challenges. Working paper 100, Program on Energy and Sustainable Development (PESD). Stanford University, Stanford, California, USA.

EBERHARD, A. 2014a. Conflict of interest at Eskom stymies SA's power supply. *Business Day*, 25 February 2014.

EBERHARD, A., 2015. Harnessing African natural gas. A new opportunity for Africa's energy agenda? : Energy and extractives global practice, The World Bank.

EBERHARD, A., 2016. SA's power lies in breaking up Eskom's monopoly model. *Business Day*, 21 July 2016.

EBERHARD, A. & GRATWICK, K. N., 2011. IPPs in Sub-Saharan Africa: Determinants of success. *Energy Policy,* 39**,** 5541-5549.

EBERHARD, A., KOLKER, J. & LEIGLAND, J. 2014. South Africa's renewable energy IPP procurement program: success factors and lessons. Washington, DC: Public-Private Infrastructure Advisory Facility (PPIAF), World Bank.

EBERHARD, A. & KÅBERGER, T., 2016. Renewable energy auctions in South Africa outshine feed-in tariffs. *Energy Science & Engineering,* 4**,** 190-193.

EBERHARD, A & Naude, R., 2017. The South African renewable energy IPP procurement programme. Review, lessons learned, and proposals to reduce transaction costs. Graduate School of Business (GSB), University of Cape Town.

EIA 2013. Technically recoverable shale oil and shale gas resources, an assessment of 137 shale formations in 41 countries outside the United States.: Energy Information Administration (EIA).

EMIRBAYER, M. & MISCHE, A., 1998. What Is Agency? *American Journal of Sociology,* 103**,** 962–1023.

ESKOM 2008. Together, rising to the challenge, Annual Report 2008. Johannesburg: Eskom Holdings Limited.

ESKOM 2012. Revenue application: Multi-Year Price Determination, 2013/2014 to 2017/2018 (MYPD 3). Johannesburg: Eskom Holdings Limited.

ESKOM 2013a. Generation Connection Capacity Assessment of the 2016 Transmission Network (GCCA-2016). Eskom Holdings Limited.

ESKOM 2013b. Standard presentation, December 2013. Eskom Holdings Limited.

ESKOM 2014. Integrated report. Eskom Holdings Limited.

ESKOM 2015a. Eskom fact sheets: Statistical table 1A, Ten-year technical statistics. Eskom Holdings Limited.

ESKOM 2015b. Grid code exemption from the network code clause for the issuing of quotes to customers. Letter from Juan la Grange, Senior Manager office of the Group Executive (transmission). Eskom Holdings Limited. Available https://www.moneyweb.co.za/wp-content/uploads/2015/10/Eskom-budget-quotes.pdf [Accessed 1 September 2019]

ESKOM 2015b. Eskom fact sheets, statistical table 1A, ten-year technical statistics. Eskom Holdings Limited.
ESKOM 2016a. Eskom presentation to the Portfolio Committee on Environmental Affairs. Cape Town. Eskom Holdings Limited.
ESKOM 2016b. Integrated report. Johannesburg: Eskom Holdings Limited.
ESKOM 2017. Eskom 2018/19 Revenue Application, Stakeholder discussion, Eskom Holdings Limited.
ESKOM 2018. Integrated Report. Johannesburg: Eskom Holdings Limited.
ESKOM 2019. Engagement on Eskom's Strategy Executive Forum. PRESENTATION BY ACTING CEO, J. M., TO SENIOR ESKOM MANAGERS AND EXECUTIVES, 22 AUGUST 2019
Eskom Holdings Limited.
ETHEKWINI 2015. Natural Gas position paper *In* MUNICIPALITY, Durban, South Africa.
FINE, B. 2010. Can South Africa be a developmental state? *In:* EDIGHEJI, O. (ed.) *Constructing a democratic developmental state in South Africa.* HSRC Press.
FINE, B. & RUSTOMJEE, Z. 1996. *The Political economy of South Africa: from Minerals Energy Complex to Industrialization,* London, C. Hurst.
FOXON, T., 2011. A coevolutionary framework for analysing a transition to a sustainable low carbon economy. *Ecological economics,* 70**,** 2258-2267.
FUENFSCHILLING, L., 2014. *A dynamic model of socio-technical change. Institutions, actors and technologies in interaction.* The University of Basel.
FUENFSCHILLING, L. & BINZ, C., 2018. Global socio-technical regimes. *Research Policy,* 47**,** 735-749.
FUENFSCHILLING, L. & TRUFFER, B., 2014. The structuration of socio-technical regimes—Conceptual foundations from institutional theory. *Research Policy,* 43**,** 772-791.
GARUD, R., HARDY, C. & MAGUIRE, S. 2007. Institutional Entrepreneurship as Embedded Agency: An Introduction to the Special Issue. *Organization Studies,* 28**,** 957-969.
GAUNT, C. T., 2008. Electricity distribution industry restructuring in South Africa: a case study. *Energy Policy,* 36**,** 3448.
GCIS 2012. 'Mineral resources', Pocket Guide to South Africa 2011/2012. *In:* SYSTEM, G. C. I. (ed.). Pretoria, South Africa.
GEELS, F. 2002a. Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy,* 31**,** 1257-1274.
GEELS, F. 2002b. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy,* 31**,** 1257–1274.
GEELS, F. W. 2004a. From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy,* 33**,** 897-920.
GEELS, F. W. 2004b. From sectoral systems of innovation to socio-technical systems: insights about dynamics and change from sociology and institutional theory. *Research Policy,* 33**,** 897.
GEELS, F. W. 2004c. Understanding System Innovations: A critical literature review and conceptual synthesis *In* ELZEN, B., Geels, F. W. & GREEN, K. (eds.) *System innovation and the transition to sustainability: theory, evidence and policy.* Cheltenham, UK: Edward Elgar.

GEELS, F. W., 2005. The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930). *Technology Analysis & Strategic Management,* 17**,** 445-476.

GEELS, F. W., 2006. The hygienic transition from cesspools to sewer systems (1840-1930): the dynamics of regime transformation. *Research Policy,* 35**,** 1069.

GEELS, F. W., 2010. Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research Policy,* 39**,** 495-510.

GEELS, F. W., 2011. The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions,* 1**,** 24-40.

GEELS, F. 2014a. Reconceptualising the co-evolution of firms-in-industries and their environments: Developing an inter-disciplinary Triple Embeddedness Framework. *Research Policy,* 43**,** 261.

GEELS, F. W. 2014b. Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. *Theory Culture & Society,* 31**,** 21-40.

GEELS, F. W. & SCHOT, J., 2007. Typology of sociotechnical transition pathways. *Research Policy,* 36**,** 399-417.

GEELS, F. W. & SCHOT, J., 2010. The Dynamics of Transitions *In:* GRIN, J., ET AL. (ed.) *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change.* Taylor & Francis Group.

GEELS, F. W., KERN, F., FUCHS, G., HINDERER, N., KUNGL, G., MYLAN, J., NEUKIRCH, M. & WASSERMANN, S. 2016. The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014). *Research Policy,* 45**,** 896-913.

GENTLE, L. 2009. Escom to Eskom: from racial Keynesian capitalism to neo-liberalism (1910–1994). *In:* MCDONALD, D. A. E. (ed.) *Electric Capitalism, Recolonising Africa on the Power Grid.* UK

GENUS, A. 2012. Changing the rules? Institutional innovation and the diffusion of microgeneration. *Technology Analysis & Strategic Management,* 24**,** 711-727.

GENUS, A. & COLES, A.-M. 2008. Rethinking the multi-level perspective of technological transitions. *Research Policy,* 37**,** 1436-1445.

GIDDENS, A., 1984. *The constitution of society*, Polity Press; New Ed edition.

GREENWOOD, R. & HININGS, C. R., 1996. Understanding radical organizational change: bringing together the old and the new institutionalism. *Academy of Management Review,* 21**,** 1022.

GRIN, J., ROTMANS, J. & SCHOT, J. 2010. *Transitions to sustainable development: new directions in the study of long term transformative change,* New York, Routledge.

HACKER, J. S., PIERSON, P. & THELEN, K., 2015. Drift and conversion: hidden faces of institutional change. *In:* MAHONEY, J. & THELEN, K. (eds.) *Advances in comparative historical analysis.* Cambridge University Press.

HAJER, M. A., 1995. *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process*, Oxford University Press.

HALL, P. A. & THELEN, K. 2009. Institutional change in varieties of capitalism. *Socio-Economic Review,* 7**,** 7-34.

HANSEN, U. E., NYGAARD, I., ROMIJN, H., WIECZOREK, A., KAMP, L. M. & KLERKX, L. 2018. Sustainability transitions in developing countries: Stocktaking, new contributions and a research agenda. *Environmental Science & Policy* 84**,** 198-203.

HARRISON, K. & SUNDSTROM, L. M., 2007. The Comparative Politics of Climate Change. *Global Environmental Politics,* 7**,** 1-18.

HESS, D. J., 2014. Sustainability transitions: A political coalition perspective. *Research Policy,* 43**,** 278-283.

HEUN, M. K., NIEKER, J. L., SWILLING, M., MEYER, A. J., BRENT, A. & FLURI, T. P., 2010. Learnable lesson on sustainability from the provision of electricity in South Africa. *Proceedings of the ASME 2010, 4th International Conference on Energy Sustainability. Phoenix, Arizona, USA, 17–22 May 2010.*

HOLTZ, G., BRUGNACH, M. & PAHL-WOSTL, C., 2008. Specifying "regime" - A framework for defining and describing regimes in transition research. *Technological Forecasting and Social Change,* 75**,** 623.

IGU 2014. International Gas Union (IGU), World LNG report.

IGU 2016. International Gas Union (IGU), World LNG report.

ISAACS, G., 2014. *The financialization of the South African Economy and the havoc it wreaks* [Online]. The South African Civil Society Information Service (SACSIS). Available: http://sacsis.org.za/site/article/1959 [Accessed 1 June 2015].

JEFFREY, L. S., 2005. Characterization of the coal resources of South Africa. *The Journal of The South African Institute of Mining and Metallurgy,* 105**,** 95-102.

JOHNSTONE, P., STIRLING, A. & SOVACOOL, B. 2017. Policy mixes for incumbency: Exploring the destructive recreation of renewable energy, shale gas 'fracking,' and nuclear power in the United Kingdom. *Energy Research & Social Science,* 33**,** 147-162.

KANGER, L. & SCHOT, J., 2019. Deep transitions: Theorizing the long-term patterns of socio-technical change. *Environmental Innovation and Societal Transitions*, 32, 7-21

KARLTORP, K. & SANDÉN, B. A., 2012. Explaining regime destabilisation in the pulp and paper industry. *Environmental Innovation and Societal Transitions,* 2**,** 66-81.

KEMP, R., SCHOT, J. & HOOGMA, R. 1998. Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis & Strategic Management,* 10**,** 175-198.

KERN, F., 2011. Ideas, Institutions, and Interests: Explaining Policy Divergence in Fostering 'System Innovations' towards Sustainability. *Environment and Planning C: Government and Policy,* 29**,** 1116-1134.

KERN, F. & ROGGE, K. S., 2018. Harnessing theories of the policy process for analysing the politics of sustainability transitions: A critical survey. *Environmental Innovation and Societal Transitions,* 27**,** 102-117.

KIVIMAA, P. & KERN, F., 2016. Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. *Research Policy,* 45**,** 205-217.

KLITKOU, A., BOLWIG, S., HANSEN, T. & WESSBERG, N. 2015. The role of lock-in mechanisms in transition processes: The case of energy for road transport. *Environmental Innovation and Societal Transitions,* 16**,** 22-37.

KÖHLER, J., GEELS, F. W., KERN, F., MARKARD, J., ONSONGO, E., WIECZOREK, A., ALKEMADE, F., AVELINO, F., BERGEK, A., BOONS, F., FÜNFSCHILLING, L., HESS, D., HOLTZ, G., HYYSALO, S., JENKINS, K., KIVIMAA, P., MARTISKAINEN, M., MCMEEKIN, A., MÜHLEMEIER, M. S., NYKVIST, B., PEL, B., RAVEN, R., ROHRACHER, H., SANDÉN, B., SCHOT, J., SOVACOOL, B., TURNHEIM, B., WELCH, D. & WELLS, P. 2019. An agenda for sustainability transitions research: State of the art and future directions. *Environmental Innovation and Societal Transitions,* 31**,** 1-32.

KONRAD, K., TRUFFER, B. & VOß, J.-P., 2008. Multi-regime dynamics in the analysis of sectoral transformation potentials: evidence from German utility sectors. *Journal of Cleaner Production,* 16**,** 1190-1202.

KUHLMANN, S., 2018. Introduction to the discussion paper on 'Three Frames for Innovation Policy: R&D, Systems of Innovation and Transformative Change'. *Research Policy,* 47**,** 1553.

KUMAR, S., HYOUK-TAE, K., KWANG-HO, C., JAE HYUN, C., WONSUB, L. & IL, M. 2011. Current status and future projections of LNG demand and supplies: a global perspective. *Energy Policy,* 39**,** 4097-4104.

KUNGL, G. & GEELS, F. W., 2018. Sequence and alignment of external pressures in industry destabilisation: Understanding the downfall of incumbent utilities in the German energy transition (1998–2015). *Environmental Innovation and Societal Transitions,* 26**,** 78-100.

KUOKKANEN, A., NURMI, A., MIKKILÄ, M., KUISMA, M., KAHILUOTO, H. & LINNANEN, L. 2018. Agency in regime destabilization through the selection environment: The Finnish food system's sustainability transition. *Research Policy,* 47**,** 1513-1522.

KUZEMKO, C., LOCKWOOD, M., MITCHELL, C. & HOGGETT, R. 2016. Governing for sustainable energy system change: Politics, contexts and contingency. *Energy Research & Social Science,* 12**,** 96-105.

LAWRENCE, T., SUDDABY, R. & LECA, B. 2011. Institutional Work: Refocusing Institutional Studies of Organization. *Journal of Management Inquiry,* 20**,** 52-58.

LAWRENCE, T. S., R 2006. Institutions and institutional work. *In:* S. R. CLEGG, C. H. T. B. L. (ed.) *The SAGE Handbook of Organization Studies.* 2 ed. London: SAGE Publications Ltd.

LAZENBY, H., 2014. Six cronimet projects progress to next South African IPP round. *Mining Weekly,* 10 March 2014.

LEDESMA, D., 2013. East Africa Gas-potential for export, Oxford Institute for Energy Studies. Oxford Institute for Energy Studies (OIES).

LETSOALO, M., MATABOGE, M. & HUNER, Q. 2014. Cosatu split, how the ANC will suffer',. *Mail and Guardian*

LEVY, D. L. & EGAN, D. 2003. A Neo-Gramscian Approach to Corporate Political Strategy: Conflict and Accommodation in the Climate Change Negotiations. *Journal of Management Studies,* 40**,** 803-829.

LOCKWOOD, M., KUZEMKO, C., MITCHELL, C. & HOGGETT, R., 2017. Historical institutionalism and the politics of sustainable energy transitions: A research agenda. *Environment and Planning C: Politics and Space,* 35**,** 312-333.

LODGE, T. & SCHEIDEGGER, U. 2006. Political Parties and Democratic Governance in South Africa. *Research Report No, 25.* South Africa: Electoral Institute for Sustainable Democracy in Africa (EISA).

LOORBACH, D., 2010. Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework. *Governance,* 23**,** 161-183.

LOUIE, E. P. & PEARCE, J. M., 2016. Retraining Investment for U.S. Transition from Coal to Solar Photovoltaic Employment. *Energy Economics* 57**,** 295–302MAHONEY, J. & THELEN, K. A. 2010. *Explaining institutional change: ambiguity, agency, and power,* Cambridge, Cambridge University Press.

MAKGETLA, N. 2016. Eskom's regulatory clearing account submission for 2013/2014. TIPS

MAKHAYA, G. & ROBERTS, S., 2013. Expectations and outcomes: considering the competition and corporate power in South Africa under democracy. *Review of African Political Economy,* 40**,** 556-571.

MARKARD, J., RAVEN, R. & TRUFFER, B. 2012. Sustainability transitions: An emerging field of research and its prospects. *Research Policy,* 41**,** 955-967.

MARQUARD, A., 2006. *The origins and development of South Africa energy policy.* PhD PhD, University of Cape Town.

MAVUSO, Z., 2015. *Gas based industrialisation vision hinges on sound policy, gas to power roll out* [Online]. Engineering news. Available: http://www.engineeringnews.co.za/article/gas-based-industrialisation-vision-hinges-on-sound-policy-gas-to-power-roll-out-2015-08-21-1 [Accessed 31 March 2016].

MCDONALD, D. A., 2009. Electric capitalism: recolonising Africa on the power grid.: London, Earthscan.

MCKINLEY, D. T., 2001. Democracy, power and patronage: debate and opposition within the African National Congress and the Tripartite Alliance since 1994. *Democratization,* 8 183–206.

MEADOWCROFT, J., 2011. Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transitions,* 1**,** 70-75.

MOHANTY, R., THOMPSON, L. & COELHO, V. S., 2011. Mobilising the State? Social Mobilisation and State Interaction in India, Brazil and South Africa. *IDS Working Papers,* 2011**,** 01-39.

Moniz, E.J., Jacoby, H.D., Meggs, A.J., Armtrong, R.C., Cohn, D.R., Connors, S.R., Deutch, J.M., Ejaz, Q.J., Hezir, J.S. and Kaufman, G.M., 2011. The future of natural gas. *Cambridge, MA: Massachusetts Institute of Technology*.

NATIONS, U., 2015. Transforming our world: the 2030 agenda for sustainable development. *A/RES/70/1.*

NELSON, R. R. & WINTER, S. G., 1982. *An evolutionary theory of economic change*, Belknap Press of Harvard University Press.

NERSA 2015a. Consultation paper on Eskom Cost of Unserved Energy (COUE). NATIONAL ENERGY REGULATOR OF SOUTH AFRICA (NERSA). Pretoria, South Africa.

NERSA 2015b. A consultation paper, Eskom cost of unserved energy methodology, Appendix B, Cost of Energy Model. NATIONAL ENERGY REGULATOR OF SOUTH AFRICA (NERSA), Pretoria, South Africa

NEWBERRY, D. & EBERHARD, A., 2008. South African Network Infrastructure Review: Electricity. *In:* NATIONAL TREASURY AND THE DEPARTMENT OF PUBLIC ENTERPRISES.Pretoria, South Africa.

NKOMO, J. C., 2009. Energy and economic development *In* WINKLER, H. E. (ed.) *Energy policies for sustainable development in South Africa* Cape Town, South Africa: Energy Research Centre (ERC).

NPC 2012. National Development Plan (NDP), 2030, Our future, make it work *In* National Planning Commission (NPC), Pretoria, South Africa

OCKWELL, D., BYRNE, R., HANSEN, U. E., HASELIP, J. & NYGAARD, I. 2018. The uptake and diffusion of solar power in Africa: Socio-cultural and political insights on a rapidly emerging socio-technical transition. *Energy Research & Social Science,* 44**,** 122-129.

OLIVER, C., 1991. Strategic Responses to Institutional Processes. *Academy of Management. The Academy of Management Review,* 16**,** 145.

OLIVER, C., 1992. The Antecedents of Deinstitutionalization. *Organization Studies,* 13**,** 563-588.

PAPACHRISTOS, G., SOFIANOS, A. & ADAMIDES, E., 2013. System interactions in socio-technical transitions: Extending the multi-level perspective. *Environmental Innovation and Societal Transitions,* 7**,** 53-69.

PASA 2012. Petroleum exploration in South Africa, information and opportunities. Petroleum Agency South Africa (PASA), Cape Town, South Africa.

PEGELS, A., 2010. Renewable energy in South Africa: Potentials, barriers and options for support. *Energy Policy,* 38**,** 4945-4954.

PENNA, C. C. R. & GEELS, F. W., 2012. Multi-dimensional struggles in the greening of the industry: A dialectic issue lifecycle model and case study. *Technological Forecasting and Social Change,* 79**,** 999-1020.

PENNA, C. C. R. & GEELS, F. W., 2015. Climate change and the slow reorientation of the American car industry (1979–2012): An application and extension of the Dialectic Issue LifeCycle (DILC) model. *Research Policy,* 44**,** 1029-1048.

PIERSON, P., 2004. *Politics in time: history, institutions, and social analysis,* Princeton, N.J., Oxford, Princeton University Press.

PIPER, L. & MATISONN, H., 2009. Democracy by accident: The rise of Zuma and the renaissance of the tripartite alliance. *Representation,* 42**,** 143–157.

PMG 2011. Industrial Development Corporation (IDC) on the implementation of the New Growth Path and Industrial Policy Action Plan (IPAP2) with special reference to the green economy and renewable energy. Parliamentary Monitoring Group (PMG).

PMG 2012. Meeting of stakeholders in the renewable energy sector: Exploring solutions to the challenges of financing and certification of locally produced renewable energy products. Parliamentary Monitoring Group (PMG).

PMG 2018. Draft Integrated Resource Plan 2018: public hearings. Parliamentary Monitoring Group (PMG): Parliament's Portfolio Committee on Energy.

politicsweb. 2012. *Cosatu's membership: All the facts* [Online]. Available: https://www.politicsweb.co.za/documents/cosatus-membership-all-the-facts [Accessed 1 April 2015].

PP 2016. State of capture. PUBLIC PROTECTOR OF SOUTH AFRICA (PP), Pretoria, South Africa.

PRESIDENCY of 2017. Speech by President Jacob Zuma on the occasion of the 37th SADC summit of Heads of State and Government.

PRESIDENCY, T., 2019. State of the Nation Address by the President Cyril Ramaphosa, Cape Town, South Africa.

RAFEY, W. & SOVACOOL, B. K., 2011. Competing discourses of energy development: The implications of the Medupi coal-fired power plant in South Africa. (Report). *Global Environmental Change,* 21**,** 1141.

RAVEN, R., 2005. *Strategic Niche Management for Biomass. A comparative study on the experimental introduction of bioenergy technologies in the Netherlands and the Denmark* Eindhoven University of Technology.

RAVEN, R., 2007. Co-evolution of waste and electricity regimes: Multi- regime dynamics in the Netherlands (1969-2003). *Energy Policy,* 35**,** 2197.

RAVEN, R. & GEELS, F., 2010. Socio-cognitive evolution in niche development: Comparative analysis of biogas development in Denmark and the Netherlands (1973-2004). *Technovation,* 30**,** 87.

RAVEN, R. & VERBONG, G., 2007. Multi-Regime Interactions in the Dutch Energy Sector: The Case of Combined Heat and Power Technologies in the Netherlands 1970–2000. *Technology Analysis & Strategic Management,* 19**,** 491-507.

RIP, A. & KEMP, R., 1998. Technological change. *In:* RAYNER, S. & MALONE, E. (eds.) *Human Choices and Climate Change vol. 2: Resources and Technology.* Columbus, OH: Battelle.

ROBERTS, S. & BLACK, A., 2009. The evolution and impact of industrial and competition policies. *In:* ARON, J., KAHN, B. AND G. KINGDON (EDS) (ed.) *South African Economy Policy Under Democracy, OUP.*: Oxford University Press

ROBINSON, V. & BRUMMER, S., 2006. SA Democracy incorporated. Corporate fronts and political party funding. Institute for Security Studies (ISS)

ROGGE, K. S. & JOHNSTONE, P. 2017. Exploring the role of phase-out policies for low-carbon energy transitions: The case of the German Energiewende. *Energy Research & Social Science,* 33**,** 128-137.

ROTMANS, J., KEMP, R. & VAN ASSELT, M. 2001. More evolution than revolution: transition management in public policy. *Foresight,* 3**,** 15-31.

RUSTOMJEE, Z., 2014. Vested interests have hijacked energy policy. *Business Day*

SAFFU, Y. Where money meets politics: Exploring policy options to regulate the influence of private funders on South Africa politics. ISS Seminar, 31 October – 1 November 2002, 2002 Leriba Lodge, Centurion, South Africa.

SASOL 2009. Sustainable development report, South Africa.

SASOL 2010. Annual review and summarised financial information, South Africa

SASOL 2018. Mind over matter, the Sasol story: A half-century of technological innovation. John Collings.South Africa.

SCHMIDT, V. A., 2010. Taking ideas and discourse seriously: explaining change through discursive institutionalism as the fourth 'new institutionalism'. *European Political Science Review,* 2**,** 1-25.

SCHOT, J. & GEELS, F. W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technology Analysis & Strategic Management,* 20**,** 537-554.

SCHOT, J. & KANGER, L., 2018. Deep transitions: Emergence, acceleration, stabilization and directionality. *Research Policy,* 47**,** 1045-1059.

SCHOT, J. & STEINMUELLER, W. E., 2018. Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research Policy,* 47**,** 1554-1567.

SCHOT, J., KIVIMAA, P. & TORRENS, J., 2019. Transforming experimentation: Experimental policy engagements and their transformative outcomes. TIPC research report

SCOTT, W. R., 2008. *Institutions and Organizations: Ideas and Interests,* San Diego, CA, Sage publications.

SCOTT, W. R., 2014. *Institutions and organizations. Ideas, interests and identities,* Stanford University, USA, SAGE.

SEGATTI, A. & PONS-VIGNON, N., 2013. Stuck in stabilisation? South Africa's post-apartheid macro-economic policy between ideological conversion and technocratic capture. *Review of African Political Economy,* 40**,** 537-555.

SENGERS, F. & RAVEN, R., 2014. Metering motorbike mobility: informal transport in transition? *Technology Analysis & Strategic Management,* 26**,** 453-468.

SINGH, S., 2014. Effects of the Mining Strikes on the South African Economy. *Mining Review Africa*

SMINK, M., 2015. *Incumbents and institutions in sustainability transitions.* Utrecht University.

SMINK, M. M., HEKKERT, M. P. & NEGRO, S. O., 2015. Keeping sustainable innovation on a leash? Exploring incumbents' institutional strategies. *Business Strategy and the Environment,* 24**,** 86-101.

SMITH, A., 2007. Translating Sustainabilities between Green Niches and Socio-Technical Regimes. *Technology Analysis & Strategic Management,* 19**,** 427-450.

SMITH, A., STIRLING, A. & BERKHOUT, F. 2005. The governance of sustainable socio-technical transitions. *Research Policy,* 34**,** 1491.

SMITH, A., VOß, J.-P. & GRIN, J. 2010. Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research Policy,* 39**,** 435-448.

SMITH, A. & RAVEN, R., 2012. What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy,* 41**,** 1025-1036.

SORENSEN, A., 2014. Taking path dependence seriously: a historical institutionalist research agenda in planning history. *Planning Perspectives,* 30**,** 1-22.

SOTARAUTA, M. & PULKKINEN, R., 2011. Institutional entrepreneurship for knowledge regions: in search of a fresh set of questions for regional innovation studies. *Environment and Planning C,* 29**,** 96-112.

SOVACOOL, B. K., 2016. How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Research & Social Science,* 13**,** 202-215.

SOVACOOL, B. K., LOVELL, K. & TING, M. B., 2018. Reconfiguration, Contestation, and Decline: Conceptualizing Mature Large Technical Systems. *Science, Technology, & Human Values***,** 1-32.

STATSSA 2017. Mining: Production and sales, December 2017. Statistics in South Africa.

STEDMAN, S. J., 1994. *South Africa, the Political Economy of Transformation* Boulder, Colorado, USA, Lynne Rienner Publishers.

Steenkamp, J.D., and du Preez, L., (2015). Introduction to the production of clean steel.

Journal of the Southern African Institute of Mining and Metallurgy. 115, 557-561

STEGMAIER, P., KUHLMANN, S. & VISSER, V. R., 2014. The discontinuation of socio-technical systems as a governance problem. *In:* BORRÁS, S. & EDLER, J. (eds.) *The Governance of Socio-Technical Systems: Explaining Change.* Cheltenham: Edward Elgar.

STEYN, G., 2006. Investment and uncertainty: historical experience with power sector investment in South Africa and its implications for current challenges. University of Cape Town (UCT).

STEYN, G., 2012. The impact of economic regulation on the management and performance of South Africa State Owned Enterprises. South African Economic Regulators Conference, Johannesburg.

STEYN, G., BURTON, J. & STEENKAMP, M., 2017. Eskom's financial crisis and the viability of coal-fired power in South Africa: Implications for Kusile and the older coal-fired power stations. Cape Town: Meridian Economics.

STIRLING, A., 2008. "Opening Up" and "Closing Down": Power, Participation, and Pluralism in the Social Appraisal of Technology. *Science, Technology, & Human Values,* 33**,** 262-294.

STREECK, W. & THELEN, K. A., 2005. *Beyond continuity: Institutional change in advanced political economies,* Oxford, Oxford University Press.

SUTHERLAND, L.-A., PETER, S. & ZAGATA, L., 2015. Conceptualising multi-regime interactions: The role of the agriculture sector in renewable energy transitions. (Report). *Research Policy,* 44**,** 1543.

SVENSSON, O. & NIKOLERIS, A., 2018. Structure reconsidered: Towards new foundations of explanatory transitions theory. *Research Policy,* 47**,** 462-473.

SWILLING, M. & ANNECKE, E., 2012. *Just transitions: Explorations of Sustainability in an Unfair World*, United Nations University Press.

SWILLING, M., MUSANGO, J. & WAKEFORD, J., 2016. The developmental States and Sustainability Transitions: Prospects of a Just Transition in South Africa. *Journal of Environmental Policy & Planning,* 18**,** 650-672.

SYMONS, K., 2016. Transnational spaces, hybrid governance and civil society contestation in Mozambique's gas boom. *The Extractive Industries and Society,* 3**,** 149-159.

TAKALA, L., 2008 The role of industrial policy and the minerals-energy complex in the decline of South African textiles and clothing. The 11th Annual Global Conference of The Competitiveness Institute (TCI), 27-31 October 2008 Cape Town.

THELEN, K. 2003. HOW INSTITUTIONS EVOLVE. *In:* RUESCHEMEYER, D. & MAHONEY, J. (eds.) *Comparative Historical Analysis in the Social Sciences.* Cambridge: Cambridge University Press.

TING, M. B., 2015. Historical Review of the Relationship between Energy, Mining and the South African economy. *In:* MYTELKA, L., MSIMANG, V. & PERROT, R. (eds.) *Earth, Wind and Fire: unpacking the political, economic and security implications of discourse on the Green Economy, Mapungubwe Institute for Strategic Reflection (MISTRA).* Johannesburg, South Africa: Real African Publishers.

TING, M. B., 2019. *PhD on Socio-technical transitions in South Africa's electricity system.* SPRU, University of Sussex.

TING, M. B., 2019. Multiple Regime Interactions, Conversion, and South Africa's Liquefied Natural Gas. *SPRU Working Paper Series (SWPS),* 08**,** 1-30.

TING, M. B. & BYRNE, R., 2020. Regime-resistance and niche-challenges: battles over rule-changes in South Africa's electricity system. *Energy Research & Social Science,* 60**,** 101333.

TOLBERT, P. S. Z., L.G., 1999. The institutionalization of institutional theory. *In:* (EDS.), S. R. C. C. H. (ed.) *Studying Organization: Theory & Method.* London: SAGE Publications Ltd.

TRANSNET 2015. Natural Gas infrastructure planning.*:* TRANSNET, South Africa

TRANSNET 2016. Natural Gas Infrastructure Planning. TRANSNET, South Africa

TROLLIP, H., BUTLER, A., BURTON, J., CAETANO, T. & GODINHO, C., 2014. Energy security in South Africa. The University of Cape Town.

TURNHEIM, B. & GEELS, F., 2013. The destabilisation of existing regimes: Confronting a multi-dimensional framework with a case study of the British coal industry (1913-1967). *Research Policy,* 42**,** 1749.

TURNHEIM, B. & GEELS, F. W., 2012. Regime destabilisation as the flipside of energy transitions: Lessons from the history of the British coal industry (1913–1997). *Energy Policy,* 50**,** 35-49.

UNEP 2017. The emission gap report 2017. UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP) Nairobi.

United Nations, (UN)., 2015. Transforming our world: the 2030 agenda for sustainable development. *A/RES/70/1*

UNRUH, G., 2002. Escaping carbon lock-in. *Energy Policy,* 30**,** 317-326.

UNRUH, G. C., 2000. Understanding carbon lock-in. *Energy Policy,* 28**,** 817-830.

VAN WELIE, M., CHERUNYA, P., TRUFFER, B. & MURPHY, J. 2018. Analysing transition pathways in developing cities: The case of Nairobi's splintered sanitation regime. *Technological Forecasting and Social Change,* 137**,** 259.

VERBONG, G. & GEELS, F., 2007. The ongoing energy transition: Lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960–2004). *Energy Policy,* 35**,** 1025-1037.

VERBONG, G. P. J. & GEELS, F. W., 2010. Exploring sustainability transitions in the electricity sector with socio-technical pathways. *Technological Forecasting & Social Change,* 77**,** 1214.

VOSS, J. P. & KEMP, R., 2005. Reflexive governance for Sustainable development – incorporating feedback in social problem solving. *Paper for International Conference of the European Society for Ecological Economics (ESEE) Lisbon, Portugal, 14–17 June 2005.*

WEBSTER, E. C., 1998. The politics of economic reform: Trade unions and democratization in South Africa. *Journal of Contemporary African Studies,* 16**,** 39-64.

WEC 2013. World energy resources. World Energy Council (WEC). London, U.K.

WEISSENBACH, K., 2011. Party finance and party competition in dominant multi-party systems: the case of South Africa. International Political Science Association

(IPSA) and European Consortium of Political Research (ECPR) Joint conference, What happened to North-South, February 16-19,2011 University of Sao Paulo, Brazil.

WIECZOREK, A. J., 2018. Sustainability transitions in developing countries: Major insights and their implications for research and policy. *Environmental Science & Policy,* 84**,** 204-216.

WINKLER, H., 2009. Cleaner Energy Cooler Climate. Developing Sustainable Energy Solutions for South Africa. Cape Town, South Africa: UCT.

WINKLER, H. & MARQUARD, A., 2009. Changing development paths: From an energy-intensive to low-carbon economy in South Africa. *Climate and Development,* 1**,** 47-65.

WISEMAN, J., CAMPBELL, S. & GREEN, F., 2017. Prospects for a "Just transitions" away from coal fired powered generation in Australia: learning from the closure of the Hazelwood power station. The Crawford School of Public Policy, Centre for Climate Economics and Policy, Melbourne.

YELLAN, C. & LILEY, R., 2019. *Paralysis over South Africa's IRP for electricity presents massive economic risk* [Online]. Available: https://www.dailymaverick.co.za/article/2019-01-17-paralysis-over-south-africas-irp-for-electricity-presents-massive-economic-risk/ [Accessed 1 August 2019].

YIN, R. K., 2013. *Case study research: design and methods*, Los Angeles, Cali. : SAGE.

Appendix A: Details of the interviews

Sector	Organization	Main issues	Date of interviews	Number of interviews
Industry/private sector	Former EIUG chair consulted on IRP.	South Africa should be the gravel pit; beneficiation does not make sense.	2 March 2016 15 July 2015	2
	Member of the South African Photovoltaic Industrial Association (SAPVIA). Part of the Business Unit of South Africa (Busa) energy task team	Eskom is heading towards a utility death spiral	7 March 2016	1
	Member of the South African Independent Power Producers Association (SAIPPA) and former chairperson for Parliamentary Portfolio on Energy	Eskom very resistant to ISMO	7 March 2016	1
	Business Development Manager at Wartsila (gas/industry)	Cannot say for sure that a volume of LNG is used per KWh, its more critical the gas gets used (power or not)	15 March 2016	1
	Senior Manager for utilities, in petrochemical company. A member of the EIUG	Nersa and Eskom had a broken relationship. Sasol has built a gas to power plant in Sasolburg. The wheeling agreement was easy because it was from Sasol to Sasol plants.	15 March 2016	1
	Provincial gas initiative- Green cape	Preparing EIAs in Atlantis to get them ready for Gas to power bids	6 April 2016	1
	Senior Manager on oil and gas, a legal firm. Part of the task team in finalizing the dti gas industrial unit (GIU).	South Africa does not have a gas market, what Sasol has developed is not a market	15 April 2016	1

	Investment Banking, Barclays Africa, Power Utilities and Infrastructure	Good overview of RE I4P finance	14 June 2016	1
	Senior Manager of a petrochemical company	Sasol is basing its growth on assumptions that it requires gas and not coal	4 May 2016	1
	Vice President of Oil and Gas for Barclays in Africa	The financial sense for Mozambique providing gas to South Africa needs time.	6 June 2016	1
	Senior Manager for sustainable development in petrochemical company	See paper on Eskom secure in power	7 June 2016	1
	Working on Liquified Petroleum Gas (LPG) for industrial use.	Worked at Sasol on the Mozambique gas project	13 July 2016	1
	Former Advisor to the Energy Minister.	Eskom resistant to renewable energy. Have a look at the potential solar corridor on the northern cape.	22 July 2016	1
	Manager at Anglo Gold Ashanti	Mines are load shifting as a response to Eskom grid instability. Safety is a crucial issue during load shedding	15 October 2015	1
	Member of the South African Oil and Gas Association (SAGOA)	Pivot of mining skills to oil and gas (Karin Project)	19 April 2016	1
	Member of the South African Photovoltaic Industrial Association (SAPVIA)	Eskom changing rules for connection to the grid.	18 April 2016	1
	Executive Business Development, Saldanha Bay, IDZ	The role of SEZs in South Africa's gas industrialization strategy (somewhat repurposing existing IDZ into specialized zones)	3 June 2016	1

Total				18
Government				
SOEs	Eskom executive	Nuclear was a clear issue at Eskom-understand the decisions are based on an energy mix	28 September 2015	1
	Eskom environmental economist	Too much too soon, with CO2 tax, IRP determines what to build.	17 March 2016 26 June 2015	2
	Eskom senior manager on pricing	Industries do subsidize tariffs-take note of this issue when it comes to tariff changes in the future	22 March 2016	1
	Eskom senior manager on power systems	Duck curve does seem a threat in the future	5 July 2016	
Industrial Development Corporation (IDC)	IDC Project Development manager	Incoherent energy policies need better alignment	1 July 2015	1
Total				5
DOE	IPP office	Gas has many moving parts. The RFQ should be out by June 2016	4 March 2016	1
	IPP office	The IRP has not been realised yet, paying caution to the nuclear issue	29 October 2015	1
	Independent energy consultant, also now at IPP office (industry)	Eskom needs a complete overhaul. Right maintenance is not being done	10 March 2016	1
	Senior Manager on integrated energy planning	Does not agree that IRP was prioritized over IEP	15 September 2015	1

	Manager on integrated energy planning	Check the industrial sector energy consumption- National Cleaner Production Centre	30 October 2015	1
Gauteng local government	Project manager: Gauteng Infrastructure Financing Agency (GIFA)	Gas to power, in all government hospitals	10 March 2016	1
Parliamentary officials	Senior African National Congress, Member of Parliament (MP), former Minister	Good insight about the developmental state, and how this is still an essential narrative within government and how it handles SOEs	21 April 2016	1
	Former African National Congress, Member of Parliament (MP)	SOEs are employment agencies	3 March 2016 17 April 2016	2
Nersa	Nersa regulatory specialist on Electricity	Eskom slipped in rules during times of crisis	12 July 2016	1
Department of Environmental Affairs (DEA)	Senior Manager in climate change transportation	Climate change mitigation is being guided towards Desired Emissions Reductions (DERO)	29 September 2015	1
	Manager in climate change and mitigation	See the national climate change (NCR) response to low carbon development in the country	30 September 2015	1
Department of Science and Technology (DST)	Manager in environment and technology	There is a groundswell of activities in climate change and renewable energy activities	21 August 2015 25 May 2016	2
The Department of Trade and Industry (dti)	Manager on renewable energy at the dti	Take note of the importance of localization of initiatives around renewables.	20 July 2015	1
	A senior manager in dti, oil and gas	Gas industrialization strategy and the unit is about to launch and clarified.	31 March 2016	1
Total				16

Think tanks	Senior economist at a South African think tank	Unbundling of Eskom study is considered, but it remains under state ownership.	10 March 2016 13 May 2016 29 October 2015	3
	Former Deputy Director General (DDG) at a government department, now a researcher at a South African think thank	Eskom eats strategy for breakfast- culture at Eskom has a way of protecting its own interests at all costs.	11 May 2016	1
	Researcher-Mistra	Pay attention to the politics of demand forecasting.	2 March 2016 10 July 2015	2
Total				6
Consultants	Consultant-infrastructure and regulatory economist	Nersa does not have the political will to challenge DOE determinations. It is more rubber stamping duties. But it is more assertive over time.	13 April 2016 13 August 2015	2
	Consultant/academic	Part of the working group on Gas industrialization strategy (GIU). The non-gas to power is very important. Importing LNG should be more than electricity use, but also industry, transport, and households.	14 April 2016	1
	Consultant and knowledgeable expert on the Mineral Energy Complex (MEC)	Understand the floor and ceiling prices of Eskom. Check EAF, UCLF, and Eskom operation parameters	12 June 2015 12 July 2016	2
	Associated researcher at the Energy Research Centre-University of Cape Town (ERC-UCT) and consultant	Long term mitigation strategy (LTMS) and its alignment to the country's low carbon strategies.	13 July 2015	1
	Former Eskom executive in Enterprise development	Financial structure of Eskom is a signal you can analyze to see if there are triggers there for change.	17 June 2016	1

Total				**7**
Academics				
	Researcher at the Energy Research Centre-University of Cape Town (ERC-UCT)	Mixed messages concerning Eskom is also a finding	12 April 2016	2
	Researcher at the Energy Research Centre-University of Cape Town (ERC-UCT)	Location of new coal sources is a tension to the old model. Significant infrastructure requirements, questions to cost plus model.	11 November 2015 7 April 2016	2
	Professor-School of Economics, University of Johannesburg (UJ)	Financialisation is also about strategy, moving money out of the country.	16 July 2015	2
	Professor UCT- Business school	Eskom often employs malicious compliance. Part of the Deputy President working team on proposed bundling of Eskom. The narrative is now re-arranging state assets as opposed to unbundling (more politically sensitive). As a way to appease trade union in unbundling Eskom could be re-arrangement of state-owned assets.	12 April 2016	1
	Professor in the School of Economics -UCT	Special Economic Zones (SEZs)- corporate tax is around 15%. Consider this for Gas I4P	9 May 2016	1
	Centre for Competition Regulation and Economic Development (CCRED)	Historical frame is that mining sector remains competitive to ensure economic development. There is, therefore, an electricity supply bias in this perspective.	24 March 2016	1
Total				8
NGOs	Researcher at WWF policy futures	IPPs is an eye wash, Eskom is stuck	3 March 2016	2
	Researcher at WWF policy futures	WWF has the convening power, Eskom is stuck in a political economy	15 December 2015 16 February 2015	3

			11 April 2016	
	Researcher at SEA (Sustainable Energy Africa)		15 April 2016	1
Total				6
Final Total				67

Appendix B: Interview questions

MEC and Eskom

- What is the current overall sentiment that Eskom has on the country energy system? (Underlying thoughts-are we still in danger of more load shedding in the future, or are the existing strategies place good enough to steer us in the clear?)
- Given the historical strategy of Eskom in the 1970s to build plants with a view of oversupply, and that it's such an integral part of growing the economy, is this still valid under the present situation? There may be a danger that we repeat the 40% reserve margin in the 1990s, which could again determine the type of customers that Eskom procurers from.
- What are Eskom's thoughts on base load, is this a problem, do future energy supply have to address this?
- How does energy planning (Eskom supply) match that of the country's ambition for re-industrialisation and beneficiation? (The implications here are that energy intensive beneficiation would require base load options, then how does energy planning match accordingly?) (More questions for DOE, but how does Eskom align to policy-if any?)
    - How is DOE planning energy according to demand?

- How does Eskom work with industry, given that mining and manufacturing are its biggest customers? (probe for EIUG working group relations)
- How does Eskom work with Nersa through the MYPD applications (probe for capabilities and knowledge base) (Ask Nersa the same question)
- For Nersa-how, does the MYPD price application work, and what is the relationship with Eskom through these negotiations?
- Could you elaborate on how Eskom derives its calculations pertaining to return on assets (Broad), depreciation, operating and primary energy costs, and claw back mechanisms? (see SAIPPA- Not allowing for the full cost of generation in the tariff, will result in the Eskom tariff being artificially low and IPP's will not be treated on an equitably basis in the South African electricity market).
- Is it true that Eskom request for price increase through the MYPDs is becoming unaffordable, if so how does it handle this situation? (Probe questions about its relationship with Nersa)
    - Related question-How is Eskom adjusting to cost reflective tariffs?
    - How does Eskom continue under economic conditions which are unaffordable for state funding and intervention? How does it move forward in the future, given all these uncertainties? (probe for privatization narrative)
- There seems to be growing appreciation for privatisation of Eskom because the state cannot continue to bail out the over stressed SOE? Is this true? (probe on discursive narratives about privatization) (ask DOE and Eskom on this)
- What are Eskom's thoughts on the successful RE IPPP? (Probe for conversion here, using IPP for other dirty fuels such as coal)
- What is the status of the IRP 2?
- Why is Eskom delaying the connection of renewable energy into the grid? (Questions for infrastructure) (There is a case here where the roll out of the RE IPPP could be too fast for Eskom to adjust, how does it manage this situation?) (there could be a mismatch between budget, time and implementation)
- Is it the case that the implementation of the IRP may be too fast for Eskom to adjust? (Did the MYPD 3 budget take into consideration time, budget of the IPPs?)

- To ask EIUG and chamber of mines- what is the working relationship with Eskom, and how does it communicate its energy-related issues with Eskom and government for policies?
    - What are its thoughts on wheeling, and are there plans to wheel electricity directly from renewable energy or gas producers?
- Chamber of mines- what is the overall sentiment on the energy supply issues in the country?
    - How does it adjust to cost-reflective tariffs?
    - What are its thoughts on privatizing parts of Eskom?
    - What are its thoughts on the IPP programme, relative to energy, coal and gas?

RE I4P

- Please describe the process: how, when, why, and by whom, was renewable energy initiated in the country?
- Could you tell me more of how the IPP came into formation?
- Are there impending changes to the IPP office given its success? (Probe for ISMO bill status, and how this office could be the implementing agent for that bill)
- Who does the IPP office it derive its mandate from? (Look out for New Generation capacity of 2009. Probe for accountability, and from which government departments does it constitute, relate it to organizational capacity, knowledge base)
- How does the IPP office participate, provide inputs, or how is it consulted during electricity price negotiations or not? (What task teams is it involved in, considering the electricity planning in the country).
- How does the work of the IPP office align to energy policy? (for example in the IRP, and Integrated Energy Planning-IEP)
- What are some of the challenges, barriers that IPP face, in order to mainstream their activities?
- How do IPPs engage with government, regulators, legislators, lobby groups and industry?
- It seems that the IPP has strong relations with the private sectors? Is this true? (has good credibility given the risks involved)

- Are IPPs involved in any wheeling agreement with vital industrial stakeholders? (probe for bypassing Eskom completely and going directly to mining companies)
- SAIPP (South Africa Independent Power Producers association) - How does the SAIPP network respond to the IRP? What are its thoughts of the future of IPP in the country?
- DOE- in the IRP there was mentioned of the solar corridor as an infrastructure development to support the roll out of renewables, what is that status on this?
- DOE- the RE IPP has been very successful, what are lessons that can be learnt from this?
- DOE-how is government handling the increasing costs of Eskom MYPD applications? Is the option of IPP a mechanism for the future? (it would seem that the IPP is a side stepping mechanism in order to mitigate the monopoly of Eskom?)
- SAPVIA, Sastela, SAWEA, SAIPPP (all renewable energy networks) - what are the challenges, threats and opportunities for renewable energy in the country?
    - What are its sentiments on IPP programme?
    - How does it participate, provide inputs and work with Eskom, regulators, policy makers and industrial networks? (probe for organizational networks, and associations)

Paper 3

- Please describe the process: how, when, why, and by whom, was gas initiated in the country?
- How does the gas IPP align to the country energy plan and industrial development?
- Could you tell me more about the gas to power IPP?
- Could you tell me about the term “anchor demand” as a way of implementing the use of gas in the country?

- Given that there will be high costs involved with infrastructure for gas to be fully realized, is this not a barrier? (Probe for alignment with existing oil and gas infrastructure, why spend so much on this and not the solar corridor?)
- Could you give me an update of the Gas Utilization Master Plan (GUMP)? How does it align to the MRPDA?
- Why are we pursuing industrial strategies that contradict green growth?
- How does industry perceive the plans for Gas IPP, and what are its broader implications? (probe for discursive narratives on broader applications of gas)
- SAGOA (South Africa Oil and Gas Association) - what are its thoughts on the gas to power programme?
- What are the plans for gas to power in the country? (Would this be related to mid merit load? Probe for flexibility of gas and how it could facilitate more use of renewables)

Appendix C: Overview of the secondary data sources used in data collection

Types of data sources	**Relevant examples of sources**	**Relevance to the thesis**
Government documents	White Paper on Energy, (1998) White Paper on Renewable Energy (2003) State of Renewables (2015) Industrial Policy Action Plan (annual by the dti) National Development Plan (NDP, 2012) Integrated Resources Plan (IRP, 2010, update 2013, 2019)	Significant energy policies formulated by government. Relevant for gas industrialisation plans in the country. Key national priorities-which articulates socio-economic goals. Critical strategy which articulates the energy mix that can meet the electricity needs of the country.
Regulatory documents	Multi Year Price Determination (MYPD) reports by NERSA Electricity Regulation Act (ERA), 2006-Section 34 New Generation Capacity (2011)	Relevant for insights into NERSA mandates, decisions made on tariffs changes, IPP policy instruments
Parliamentary hearings	The Mineral Resources and Energy Portfolio Committee The Environment, Forestry, and Fisheries Portfolio Committee	Key energy policy debates, IRP updates, quarterly performance, electricity tariffs, Plans for reduction in GHG emissions, ratification of Paris Agreement all have implications on Eskom, and RE I4P implementation.

	The Public Enterprises Portfolio Committee Standing Committee on Appropriations Standing Committee on Public Accounts (SCOPA)	Shareholder Ministry- convenes numerous stakeholder engagements Eskom special appropriation bills Scrutinises financial statements, Eskom board decisions and forensic investigations.
Industry reports	Eskom reports- Integrated results, released annually International Gas Union (IGU)	Critical documents, which outlines key developments in Eskom Global association which provides rich technical data into gas.
Newspaper articles	Business Day Mail and Guardian Engineering news	Up to date developments and policy debates, particularly useful in formulating questions for interviewees, in order to validate statements or quotes made in public records.
Academic articles	International Journals- Environmental Innovation and Societal Transitions (EIST), Energy policy, Energy Research and Social Science (ERSS), South African Journals- Journal of Energy, Journal of Southern African Institute of Mining and Metallurgy (SAIMM)	Useful theoretical insights into sustainability transitions, energy research and policy Useful for gaining insights into local research concerning Eskom, mining, coal and gas.

Appendix D: Glossary of salient terms and definition

Terms	Definitions
Agency	In this research, agency is defined as the capacity of actors to express action through routines, habits, the imagination of possible alternatives of the future and practical judgement of ambiguous or constantly evolving circumstances in the present (Emirbayer and Mische, 1998).
Conversion	Redeployment of old institutions to new purposes and new goals.
Drift	According to institutional change theory, drift represents an effort to hold on to existing rules in the face of contextual change, where that change creates a need for new rules (Hacker et al., 2015).
Displacement	Removal of existing rules and replacing them with new ones.
Layering	Layering is a mode of institutional change in which a new rule is added to existing rules rather than replacing them outright (Streeck and Thelen, 2005).
Regime	Relatively stable and aligned sets of rules directing the behaviour of actors along the trajectory of incremental innovation, present in a single socio-technical system (Geels and Shot, 2010, p. 12). The combination of rules and resources, in turn, manifests itself in recurrent patterns of practice (e.g. the trajectory towards incremental innovation in mature system).
Rule	A humanly devised constraint that structures human action leading to a regular pattern of practice, present in a single socio-technical system (Schot and Kanger, 2018). The rules of socio-technical regimes account for the stability and lock in of socio-technical systems. Building on neo-institutional theory, Geels (2004) using Scott's (2008) three rules proposed that regimes contain three types of rules: cognitive, regulative and • Examples of **regulative rules** are regulations, standards and laws. • Examples of **cognitive rules** are belief systems, guiding principles, goals, innovation agendas, problem definitions and search heuristics. • Examples of **normative rules** are role relationships, values and behavioural norms.
Socio-technical system-	Configuration of actors, technologies and institutions for fulfilling a certain societal function.
Structures	Defined as reproduction in cognitive, regulative and normative rule, which are influencing features that guide actor's behavior. It is the process of alignment and embedding of these rules within society,

	as well as their ongoing reproduction and enactment which leads to the creation of structures (Geels and Schot, 2010)
Regime shift	Regime shift involves changes in technologies and technical artefacts as well as in user practices, policies, markets, industrial structures, and supporting infrastructures. (Markard and Truffer, 2008 p.603)

Elaboration of rules as it is understood from institutional theory. The basis by which rules are enacted through regulative, normative and cognitive institutions (Scott, 2008)

	Regulative	**Normative**	**Cognitive**
Compliance	Expedience	Social obligation	Taken for granted
Order	Regulative rules	Binding expectations	Constitutive schema
Mechanisms	Coercive	Normative pressure	Mimetic
Logic	Instrumentality	Appropriateness	Orthodoxy
Indicators	Rules, laws, sanctions	Certification, accreditation	Common beliefs shared logics of action
Basis of legitimacy	Legally sanctioned	Morally governed	Culturally supported

Appendix E: Visual representation of the changes and events in South Africa's electricity system over social media.

Eskom

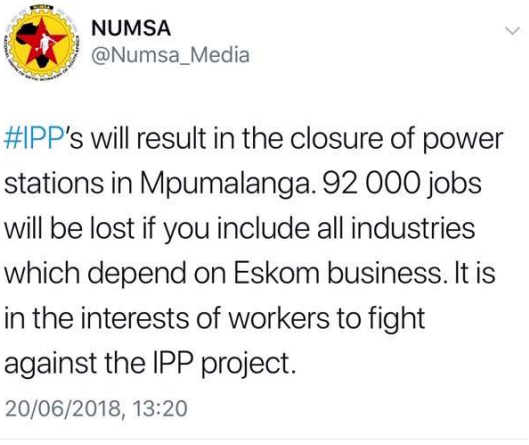
Announcement by the Presidency office, on the 15th Jan 2019. The Eskom sustainability task team, which has advised the president on the potential action to resolve the utility operational, structural and financial challenges.

Announcement by the president, Cyril Ramaphosa on unbundling Eskom, into generation, transmission and distribution in his State of the Nation Address (SONA), 20 June 2019, Pretoria, South Africa.

Trade unions

Congress of the South African Trade Unions (COSATU), which are very important in the negations of Eskom's future. Here the march is against the privatization of Eskom, as announced by voice of the Cape on the 19th February 2019.

The National Union of Mineworkers in South Africa (NUMSA), response to Eskom, as the utility suggested an earlier shutdown of its older coal mines, in order to accommodate renewables. The announcement here is on the 14th and 20th June 2018 respectively.



Gas

A statement by Jeff Radebe, Minister of Energy on the 5th September 2018, at the Africa oil and power conference, Cape Town, South Africa. This highlights the significance gas in the country's energy mix.